Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by R. Gabler, Interlaken.

Retaining wall across Kauteneübach.

VOLUME XXXV NUMBER 1

INDIAN FORESTER

JANUARY, 1909.

REGULATIONS FOR 1909 AS TO THE APPOINTMENT OF PROBATIONERS FOR THE I.F.S.

The Regulations* as to the appointment of Forest Probationers for 1909 have only just reached us, although as evidenced by the article in the *Cambridge Review* which we reproduce this month, they have been public property for some time in England We propose to review the new Regulations with reference to the changes introduced and the influences thereof in the future recruitment of the Department.

Rule 1 states that not less than 12 appointments will be made during 1909 and that the Secretary of State will be aided in making these appointments by a Selection Committee. Of the constitution of this Committee nothing is said. Hitherto we believe that it has consisted entirely of gentlemen connected with the India Office, but for many reasons in these days of outspoken criticism we should prefer the appointment of a Rejection Committee whose members should comprise not merely departmental officers but others interested in English forestry and science education, and whose duties

* *Vide* p. 51 of the present number.

would consist in eliminating unsuitable candidates leaving the residue to prove their relative ability by the arbitration of competitive examination. We hope that it may be the intention of the Secretary of State now or later on to take action on these lines, especially as the Regulations state that should there be an excess of candidates, recourse will be had to competitive examinations by the Civil Service Commissioners.

In rule 3 it is laid down that all candidates must on presentation be under the age of 23 on the 1st July 1909, but candidates are divided into two classes :—

(*a*) those who possess an Honours Degree in Natural Science from any University in Great Britain or Ireland and have a knowledge of mathematics including plane trigonometry, and

(*b*) those who have a good general education including a good knowledge of chemistry, mechanics and physics.

Taking the candidates under (*a*) above, probationship may extend over two years, a period considered necessary in order to obtain a Diploma of Forestry at Oxford, but special consideration will be shown in the first instance *by the Selection Committee* to those candidates who already hold a Diploma of Forestry from any other University and also the prescribed course of two years at Oxford may be shortened for them, while as regards the necessity to take a second Forestry Diploma at Oxford, the matter will be specially considered. To candidates selected in class (*a*) a stipend of £240 or £120 per annum will be given, and the fees payable to local Forest Officers in England and abroad will also be disbursed.

In the case of candidates of class (b) considerable restrictions are imposed. They must be not less than 19 years of age on the 1st July 1909, they must become members of the University of Oxford and remain there for three years apparently in order to obtain a Science Degree and the Diploma of Forestry and they will receive the same total stipend of £240 divided into three payments of £80 per annum.

Nothing is said about the lengthy residence in German forests which it has been the custom to insist upon at the close of the

University course, but as the college vacations of stipendiary students are now to be utilised for the purpose of practical study in British and Continental forests and these vacations extend over one-third of each year, we trust that the residence on the Continent will now be abandoned in favour of prolonged and leisurely touring under suitable supervision which in our opinion will be far more beneficial to the practical training of our recruits.

We welcome the new Regulations as an immense step in advance and one which must lead ultimately to the full recognition of Forestry as a science by all the leading Universities. It depends on the action taken by them whether or not the University of Oxford shall continue to enjoy a monopoly in imparting a knowledge of scientific Forestry to the youth of England and her dependencies. It is not possible to conceive that the Universities of Cambridge and Edinburgh, for instance, will continue to acquiesce in the present state of affairs or permit the inference that the Diploma or Degree in Forestry to be conferred by them is or will be of less value than that issued by the University of Oxford They will certainly make every effort to compete with Oxford in this regard in spite of the monetary and other advantages which that University has possessed during the last three years and which apparently for the present at least is to be continued until this assistance is proved to be no longer indispensable for the progress of Forestry education.

There are two points in the new Regulations which are somewhat difficult of explanation unless the new scheme is recognised to be at present somewhat tentative in its nature. First there appears to be an undercurrent of doubt whether or not Honours men in science will at first be forthcoming in sufficient numbers as Forest Probationers. Enquiry amongst the authorities of the leading Universities shows that in their opinion there will be, at least after a time, little difficulty in obtaining such recruits, and they strongly deprecate the system by which youths of 19 shall be engaged during the three years of probation in taking a Science Degree and *at the same time* in studying for a special diploma. This objection is strengthened by the new rule that vacations shall be

utilised in practical Forestry. If the forecast of those most qualified to know should turn out to be incorrect, it is yet highly improbable that the Forestry education of English youths should continue to be monopolised by one University, and it seems certain that the others who are already taking steps to secure their position, as regards instruction in this science, will lay claim to a further relaxation of the rules in order to enable them to compete in the provision of trained foresters for the service of the Empire selected from amongst those who possess a good general education. Next it is comprehensible that the candidate with a good general education should remain as a probationer for three years at Oxford or some other University, as this is the term necessary to take a degree or diploma. But why the Honours men should continue in probation for two years is a matter not so easily explained? If he possesses a Diploma in Forestry from any other University competent to confer one, we should have thought that after having received practical instruction in Continental Forestry he would be quite prepared to be introduced to Indian conditions under proper guidance—a proceeding which an eminent Indian statesman has said no home training can take the place of in importance to the Indian people and to the officer concerned. No mention is made in the Regulations as to this introduction or the manner in which it is to be secured, but we have no doubt that the Government of India are fully convinced of the vital necessity of arranging that this is adequately carried out whether or not it forms part of the curriculum imposed by the Secretary of State. In point of fact it appears to us that the Indian training of passed probationers is a matter more directly within the cognisance and duty of the employer than of those who take only the responsibility for the general and technical education of the recruit, and we have no doubt that the very casual treatment of the newly joined recruit which obtained in the past will before long give way to a systematised training on practical lines during the first year in the country. As before said we welcome these Regulations and believe that they will tend to place forest recruitment on a firm and satisfactory basis, replacing efficiently the constant changes of the past by a permanent system both effective and equitable.

SCIENTIFIC PAPERS.

THE INDIAN FOREST SERVICE.

REGULATIONS AS TO THE APPOINTMENT OF PROBATIONERS, 1909.

1. *Appointments.*—The Secretary of State for India in Council will, in the summer of 1909, make not less than 12 appointments of Probationers for the Indian Forest Service, provided that so many candidates are considered to be in all respects qualified. In making these appointments, he will act with the advice of a Selection Committee.

2. *Applications for Appointment.*—Applications for appointment must be made on a printed form to be obtained from the Secretary, Judicial and Public Department, India Office, Whitehall, London, S.W., and to be returned to him not later than Thursday, the 1st July 1909. Candidates must be prepared to present themselves for an interview with the Selection Committee within three weeks from that date.

3. *Age Limit.*—Candidates must be under the age of 23 years on the 1st July 1909.

4. *Nationality, &c.*—Every candidate must be a natural born British subject. He must be unmarried, and if he marries before he reaches India he will forfeit his appointment. He must be of good physique, and must produce satisfactory evidence of character.

5. *Qualifications.*—Candidates must bring evidence, for the consideration of the Selection Committee, to show that they have passed with honours in a public examination for a degree in some branch of Natural Science, held by a University in Great Britain or Ireland, and that they possess a knowledge of mathematics up to and including plane trigonometry. Special consideration will be given to candidates who possess a Diploma in Forestry granted by a British University.

6. In case the number of duly qualified candidates, who have taken such a degree or diploma, is not sufficient to fill the number of appointments, the Secretary of State for India in Council will

nominate candidates who bring evidence to show that they have received a good general education, and that they have a good knowledge of chemistry and mechanics and physics as indicated in the appended syllabus (Appendix I). *A good general education* should be understood to include, at the least, a fair knowledge of English composition, mathematics up to and including plane trigonometry, Latin, and either German or French. A knowledge of Greek is not necessary, but is left to the option of the candidates. The production of school certificates granted by the examining authorities of Universities, or of certificates that a candidate has passed the Matriculation Examination of a University, in the subjects named, or of other certificates held by the Secretary of State in Council to be equivalent, will be taken to show that a candidate satisfies the requirements of this clause. Candidates of this class must not be less than 19 years of age on the 1st of July 1909.

Should there be more candidates, considered by the Selection Committee to be qualified in every respect, than vacancies to be filled, the Secretary of State reserves the right to require them to pass a competitive examination conducted by the Civil Service Commissioners, on the results of which their final selection would depend.

7. *Medical Examination.*—Those candidates who are selected as probationers will be required to undergo a strict examination by a Medical Board at the India Office, at which particular stress will be laid on good vision and hearing.

On passing this medical examination candidates will be deemed to be probationers for the Indian Forest Service.

8. *Period of Probation.*—In the case of probationers who have passed with honours in Natural Science, as indicated in paragraph 5, the period of probation will extend over two years. In the case of students who have obtained a Diploma in Forestry the period may be two years or less, as may be specially arranged. The probationers will be required to undergo a special course of study at Oxford, and to become members of the University, if not so already. During the vacations they will receive under suitable supervision, practical instruction in such British and Continental

forests as may be selected for the purpose. Excursions are also made for purposes of study in term-time.

In the case of probationers who have not passed with honours in Natural Science, the period of probation will extend over about three years.

Probationers must obtain the Diploma of Forestry of the University of Oxford; those who have passed with honours in Natural Science within two years, and the others within three years. The case of students who have already obtained at another University such a diploma will be specially considered.

9. *Charges.*—The probationers will be required to defray all expenses of lodging, board, tuition, and excursions, while at Oxford, and on practical instruction in Britain and on the Continent, with the exception of fees payable to local Forest Officers in Britain and on the Continent.

10. *Allowances.*—The Secretary of State for India in Council will pay to each probationer possessing a Degree in Natural Science, or a Diploma in Forestry, the sum of £120 annually, or a total of £240 (besides the fees to local officers mentioned above). These payments will be made on the following dates in each year:—

On the 1st December	...	... £30
On the 1st March	...	... £30
On the 1st June ...	...	... £60

In the case of probationers who have not passed with honours in Natural Science or obtained a Diploma in Forestry before being appointed probationers, the Secretary of State in Council will give the same total allowance of £240 (in such instalments as may be required to meet the expenses of the practical work), and will defray (as above) the fees payable to local Forest Officers.

The grant of the allowances is subject to the following conditions:—

(*a*) that the progress of the probationer in his studies is satisfactory;

(*b*) that the probationer gives security to refund the payments in case he fails to join the Indian Forest Service at the end of the period of probation.

11. *Conduct.*—Every probationer will be required to conduct himself during the period of probation in a manner satisfactory to the Secretary of State, and to give evidence of satisfactory progress in his studies in such a manner as may be required, failing which, or in the event of serious misconduct, he will be liable to have his name removed from the list of probationers.

12. *Appointment and Seniority.*—Probationers who obtain the Diploma of Forestry, and are of sound constitution and free from physical defects, which would render them unsuitable for employment in the Indian Forest Service, will be appointed Assistant Conservators in the Indian Forest Department. Their position in the provincial Forest Lists will be determined by the results of the examinations held during their probation; but in making selections for the post of Conservator, officers of the same year are reckoned as equal in seniority.

They will be allowed at the end of the period of probation to state their preference in respect to the Provinces to which they desire to be allotted; but the distribution will be made to the several Provinces according to the needs of the public service, at the discretion of the Secretary of State for India. Officers are, however, at all times liable to be transferred from one Province to another at the pleasure of the Government of India.

13. *Riding.*—Every probationer, before proceeding to India will be required to satisfy the Secretary of State, in such manner as may be determined, of his ability to ride.

14. *Articles of Agreement.*—Within a month of his nomination as Assistant Conservator, each nominee must sign articles of agreement describing the terms and conditions of his appointment; he must embark for India when required to do so by the Secretary of State, and must engage his own passage. Failure to embark at the stated time will, in the absence of satisfactory explanation, lead to forfeiture of appointment.

15. *Salary.*—An Assistant Convervator of Forests will draw pay at the rate of Rs. 380 a month (equivalent to £304 a year, *when the rupee is at 1s. 4d.*) from the date of his reporting his arrival in India.

16. *Promotion, Leave, Pension, and Provident Fund.*—Promotion, leave, and pension will be governed by the Regulations laid down by the Government of India, and applicable to Forest Officers such Regulations being subject to any modifications or alterations which may be made in them from time to time by the Government of India, and their interpretation in case of any doubt arising being left to that Government. A copy of the existing Regulations can be seen on application at the India Office.

Certain information regarding appointments in the upper controlling staff of the Indian Forest Service, the pay of which has been recently improved, will be found in Appendix II; a summary of information regarding leave is contained in Appendix III; and regarding pensions and the Provident Fund in Appendix IV.

INDIA OFFICE:
27th October 1908.

[The appendices are omitted.—HON. ED.]

RATE OF GROWTH OF FOREST TREES IN THE FEDERATED MALAY STATES.

BY A. BURN MURDOCH.

On this subject, the most important in forestry, little or nothing is known as regards trees which grow in the Malay Peninsula. The difficulties in the way of ascertaining the age of trees, especially growing in dense forest, where no observations have hitherto been made are very great.

Malays as a rule smile if asked to give their opinions to the age of any given tree, and I suppose that their amusement is natural, as, after all, it is the most difficult question to answer, and one they have never been called on to investigate, as there is more than sufficient timber for their wants.

In India where dry deciduous mixed forests predominate, many of the more important timber trees have very clearly defined annual rings, due to the complete change in seasons, and a definite season of rest from growth, or to the sudden and quick growth in the spring when new leaves are put on.

Thus with Teak the annual rings are so well defined that in any given forest the rate of growth may be accurately gauged by means of an instrument called "Pressler's borer."

This is simply a hollow steel borer which is screwed into the tree to a depth of 2 to 3 inches. Inside the tube is inserted a small steel wedge-like pin. When the borer has been inserted to a sufficient depth this pin is tapped smartly and then the borer withdrawn by turning to the left, bringing with it a clean cylinder of wood about 2 to 2½ inches long.

The rings are then counted and the length of the cylinder accurately measured.

It is usual to take three borings from each tree.

In gauging the rate of growth of teak in a forest the trees are divided into four classes as under :—

Class I	...	...	6′ to 7′ in girth.
do. II	...	...	4½ to 6′ „
do. III	...	...	3′ to 4½′ „
do. IV	...	...	under 3′ „

A hundred or more borings are made in each of these classes so that trees of all sizes are gauged. Thus an absolutely reliable result is obtained Some borings which were taken in making a working plan of a forest reserve in Burma may be of interest and I give them here.

Class IV.—Trees under 3′ in girth, 63 bored, 189 borings, average annual ring ·097522″. Average annual girth increment ·612748″, therefore 59 years to attain a girth of 3′.

Class III.—3′ to 4½′ in girth, 62 trees bored, 186 borings average annual ring ·106043″. Average annual girth increment .666287″, therefore it takes a teak tree 27 years to pass from 3′ girth to 4½′ in girth

Class II.—4½′ to 6′, 64 trees bored, 192 borings. Average annual ring ·09408″, average annual girth increase .591128″, therefore it takes a tree 30 years to pass from 4½′ to 6′ in girth.

Class I. 6′ to 7′ in girth, 68 trees bored, 204 borings Average ring ·073362″, average annual girth increase ·460947″, it takes therefore 26 years to pass from 6′ to 7′ in girth.

Adding these results together we get—

to reach a girth of 3′	...	59 years.
to pass from 3′—4½′	...	27 „
„ 4½′—6′	...	30 „
„ 6′—7′	...	26 „

Therefore for a seedling to reach 7′ in girth 142 years.

A few years are always added on to this result to allow of a teak seedling to have established itself.

In the same forest as above 24 stumps and logs were measured and the rings counted. The result worked out to 149 years to attain a girth of 7′ and for the purposes of the working plan 150 years was decided upon as the age.

The above illustrates with what accuracy this little instrument will gauge the rate of growth of trees. Of course in using this instrument iron wood must be avoided, or it will snap off.

It will be successful in woods considerably harder than teak, but would I fancy be useless in trees such as Chengal, Merbau, Penaga, Belian, etc. However, as these trees do not appear to have definite and well marked annual rings, we are thrown back here upon a very slow and tedious method, but one which is of course absolutely accurate, *i.e.*, to measure annually as many trees as possible, and to take trees of all sizes. At first sight it would seem that this would mean waiting 100 years or more for results, but this is not the case. Thus taking the divisions into classes as in India above shewn, we will suppose that of the 407 trees I have had measured in the F. M. S. forests—

100 are in class	I	6′ to 7′	girth.
100 „ „ „	II	4¼′ „ 6′	„
100 „ „ „	III	3′ „ 4½′	„
107 „ „ „	IV	under 3′	„

at the time of first measurement. Then it is obviously not necessary to continue measuring a tree in Class IV right through all the classes but only until it has reached Class III; *i.e.*, suppose that we find that it takes 40 years for a tree to reach 3′ in girth, 25 years to pass through Class III, 30 years to pass through Class II and 35 years to pass from 6′ to 7′, then we will in 40 years know how

long it takes the average tree to reach a girth of 7 feet, *i.e.*, 130 years. As regards the actual results so far as we have gone, I have before me three years of measurements of Chengal (*Balanocarpus*) and Merbau (*Afzelia*) taken in Bilut Reserve near Raub.

These big forest trees are measured at 20′ from the ground to avoid buttresses.

The forty Chengal trees shew these results :—

	Class I.	Class II.	Class III.	Class IV.
Average increase in girth in two years	·56″	·58″	1·25″	·75″
Average increase in girth in one year.	·28″	·29″	·62″	·37″

These results, if they could be relied upon, would be of course discouraging, as it would take a tree at this rate 97 years to attain a girth of 3 feet, 29 years to pass from 3′ to 4½′, 62 years to pass from 4½′ to 6′, and 42 years from 6′ to 7′, a total of 230 years.

As a matter of fact measurements cannot be relied upon until after about 10 or 12 years, because in dealing with these large timber trees the bark is constantly breaking away owing to expansion by growth, and growth may be more in one year than another. A very little bark breaking off a large tree would make a great difference. This factor will be eliminated more or less after several years of measurement.

100 Getah Taban trees (Gutta percha, *Palaquium gutta*) have been measured near the waterfall at Taipeng, of girths varying from 18 to 65 inches.

These show a much more rapid rate of growth, 1·69 inches per annum, or 42 years to reach a girth of 6 feet at 6 feet from the ground. What at first sight seems remarkable is the great differences in rate of growth, *e.g.*, some trees have grown in the seven years as little as 3 inches in girth while others have put on 20 to 24 inches. There is no doubt that in natural forest in this country where the naturally sown seedling has to struggle for existence with a minimum of light, the girth increment is almost absent altogether until the crown of the tree gains access to light.

I have seen this exemplified in Trollah Reserve, where undergrowth has been cleared over about 2,000 acres to assist young Taban. A frequent sight after such a first clearing is a long thin Taban tree about 30 to 40 feet high but only a few inches in girth. When the surrounding thick undergrowth is cut away these trees cannot bear their own weight at first, and bend over to a greater or lesser degree, sometimes so much as to require propping up. The girth increment of such a tree may be said to have been almost absent for years, all the energies of the tree being put forth in height-growth in an effort to reach the light

When light is artificially admitted by cutting the surrounding growth, the girth increment will doubtless increase with great rapidity, and more leaves be put on. The inference is that the duty of the Forest Department in these forests is to assist valuable species, such as Chengal and Merbau to establish themselves, by letting in light.

From observation of the big forests in Kuantan and elsewhere, the conclusion has been forced upon me that the large solitary Chengal trees found there are of immense age, certainly not less than 300 years old. The almost complete absence of trees say 2' to 4' in girth is a very marked feature and a very serious problem for the forester.

It is obvious then that there is an immense field for the study of the rate of growth of timber trees and that a great deal depends upon it. Now that the Forest Department has been gradually increased in numbers, experiments will be made in clearing round young trees in the forest and measuring these trees annually, then comparing their rate of growth with trees uncleaned. Some few thousand Chengal and Merbau trees which were planted in 1898 in the Pondok Tanjong Rubber Plantation have grown exceedingly well and are probably four times the girth of trees of the same age in big forest.

These trees have had the partial shade of Heveas from the beginning, being planted in rows alternately with Heveas about 22' apart by 12' in the line. The average girth increment in 11 Merbau trees for one year is 1·15" and for 20 Chengal trees 1·19". This

would give 31 years to reach a girth of 3′ for the former and 30 years for the latter, a very different result to that obtained from the measurements of trees in big forests as already given, where 97 years was the period required.

The method I have adopted in the forests is to cut lines 33′ apart through the undergrowth, and to plant trees 33′ apart in these lines. So far considerable success has been attained, especially with Merbau. It is probable that trees so planted will grow much more quickly than in their natural state. As they grow older light will be let in by judicious cutting of trees which are overshading them. In a few year's time it is hoped to have some definite results as to comparisons in the rate of growth of trees and self-sown trees growing in the forests. The accurate measurement of forest trees is a matter requiring the close attention of all Forest Officers and measurements to be reliable must not be left to Malay Rangers, and as the trees are often in remote forests the work is slow and expensive. Without definite information on this head however no systematic working of the forests can ever be undertaken.—(*Agricultural Bulletin of the Straits and F. M. S.*)

ORIGINAL ARTICLES.

NOTES ON THE TORRENT TRAINING-WORKS AND RE-BOISEMENT OF MOUNTAIN SLOPES NEAR INTERLAKEN.

(*With seven plates.*)

The Interlaken Forest division (*Bezirk*), with headquarters at Interlaken, extends southwards of that town to the Jungfrau range of Alps, embracing the valleys of the two Luetschines and the slopes overhanging the southern shore of the lake of Brienz as far as Iseltwald. To the north it includes the Harder mountain and part of the Beatenberg ridge (on the lake of Thun).

The elevations range from 1,800 feet to tree limit at about 7,500 feet and even above, for, to a certain extent, the Forest Officer is concerned with the Alpine pasturages.

All aspects and every degree of gradient are forthcoming. The rock is a laminated calcareous shale readily weathering into slabs and flakes.

The total area under forest amounts to 10,000 hectares (approximately 25,000 acres) of which about 8,000 are the property of the several village communities, about 1,400 belong to private parties and 600 form the State forests (Canton of Berne).

The whole area is looked upon as *Protective Forest* and is therefore under State administration, the main object of management being the protection of the slopes against erosion and denudation.

In general the tracts are precipitous and in the higher ranges, indeed often so steep as to afford no foothold whatever. Moreover there is a great deal of sheet rock.

In numerous places avalanches are habitual during the winter Such are characterised by the bare strips of the avalanche tracks alternating with stunted tree and shrub growth naturally protected from this destructive agency by the configuration of the ground.

In the past, owing to unrestricted goat browsing and removal of hay and litter (but specially the first named), much disforestation and denudation has taken place. Here the evil influence of the goat is patent and the incompatibility of forests and goats forces itself upon one.

Now-a-days, wherever necessary, goats are excluded under the provisions of the Swiss Forest Law, and the practice of stall feeding is being substituted for browsing at liberty.

The chief species of trees occurring in these forests are beech, Alders (*Alnus viridis, incana and glutinosa*) willows (2 or 3 species), walnut, hazel, ash (not plentiful) *Robinia* (planted) *Sorbus* (*S. aria* and *aucuparia*) and Maple and for Conifers, silver fir, spruce larch (mostly planted), *Pinus Cembra*, *P. pumilo* and *P. austriaca* (the last two planted in small quantities only) and *P. sylvestris*. The latter species occurs in small numbers and is confined to the lower elevations as it suffers greatly from snow break.

The broad-leaved species do not, as a rule, ascend above 4,400 feet Spruce to about 5,600 feet, silver fir to 7,000 feet and the Cembran pine to 7,500 feet.

Walnut, though thriving excellently at the lower elevations is not indigenous. It is said to have been introduced by monks in the thirteenth century. It is now acclimatised and has run wild. It crops up naturally everywhere, and is especially useful on rocky slopes where it comes up in the fissures of rocks in situations where other species cannot accommodate themselves.

The soil, the product of the calcareous rock, where at all deep is good and loamy giving excellent growth. Spruce attains its maximum of about 115 feet in 150 to 160 years. Larch and silver fir about 100 feet in 100 to 120 years, with a maxium diameter of 21 inches. Beech averages 91 feet and Cembran pine does not exceed 81 feet.

As already stated, a great deal of denudation was allowed to go on in the past, principally through long continued goat-browsing but partly owing to unregulated felling and unrestricted removal of hay and litter. The latter, however, does but little harm under the conditions generally existing in the locality. It is the goat that is chiefly to be held up to opprobrium. With the goat there is no possibility of natural regeneration. Every thing green within reach is devoured by these voracious animals, moreover their sharp hoofs loozen the soil they have uncovered which latter is washed down by rain and melted snow.

This begins along stream banks and spreads by degrees till wide strips are involved. The streams becomes torrents which further erode their banks till, in course of time, large areas and whole slopes are brought to ruin.

Entirely denuded of all vegetation, the surface of the slopes consists of *loose stones and boulders which every fall of rain* sets in motion. The fields and even the villages at the foot are endangered.

Such sites were to be met with throughout the Interlaken division as well as almost all over the Bernese Oberland.

It is obvious that vigorous meaures to counteract these evil tendencies were urgently necessary. The first step to be taken was the exclusion of the goat; and this precaution alone proved immediately beneficial. Areas from which tree growth had almost

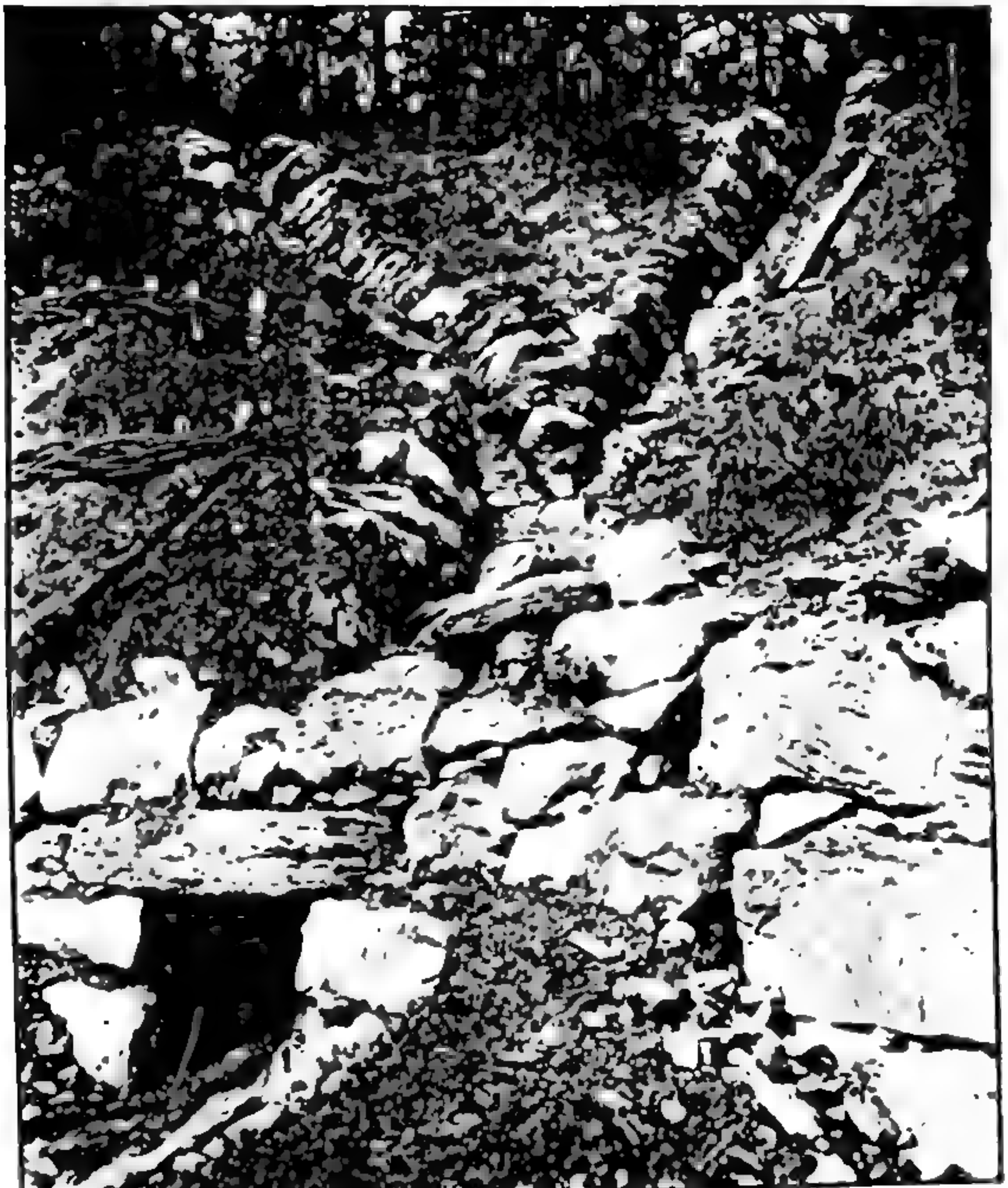

Photo. Mech. Dept. [illegible]

Photo. by B. Gabler, Interlaken

Channel constructed to train stream.

or entirely disappeared, but not yet denuded of soil, soon showed a promising crop of young growth, now its arch enemy was removed.

Scattered and sparse at first, this growth consisting of regrowth from mangled stocks or seedlings risen from immigrant seed, soon became denser, so that the rehabilitation of forest was merely a question of time.

Sheep are also harmful though in a much smaller degree, but cattle, on the other hand, do but little damage in these zones. The cause lies, no doubt in the differing habits. Cows and bulls prefer gentler slopes where there is ample grass. Further their numbers are restricted by the titles to graze and more cattle than can be maintained, either in the fields or by stall feeding (practically all graze in the alpine pastures in summer and are stall-fed at the lower elevations in winter) are not kept, the surplus being sold out of the community.

The grazing areas, which often contain scattered forest growth intermixed with pasture, are mostly the property of what are known as *Alpengenossenschaften* (practically limited companies for the enjoyment of alpine tracts). The members have each the right to graze a definite number of head of cattle. The several titles may be for varying numbers, much as shareholders in a commercial enterprise hold shares of varying quantity. The shares are similarly saleable and usually change hands at from 200 to 500 francs per head of cattle. Holders of titles are at liberty to lease out their right to other parties.

All general revenue from, and expenditure on, these lands are divided among the members, *pro ratio* of their interest. One full grown head of cattle is considered equivalent to 2 young ones and to four goats.

Fortunately the Swiss Forest Law enables the restriction of all practices (including browsing and grazing) inimical to the conservation of hill slopes.

These interdictions are rigorously applied, though always introduced as gradually and considerately as circumstances allow. Here, as elsewhere, the secret of success in such operations is to

make the local population understand that the precautions adopted are in their own interest, thus securing their co operation.

Power to compel owners to protect their forests as well as power to acquire their property is also conveyed by the Act

Definite schemes of protection for a whole tract are prescribed and are duly carried out after receiving sanction from the Federal authorities at Berne Under this plan the local Forest Officer (*Oberförster*) proposes the inclusion of defined areas in the protective tract, to be maintained as (or brought under) forests or mixed forests and pasture locally known as *Witweide* or *Weidwald*). The required degree of afforestation having been obtained, it is encumbent on the owner (whether state, community or private) to maintain it The local Forest Officer must therefore have control over all such areas and all removals of timber are made under the provisions of definite working plans.

In the areas under *Witweide* timber is not felled for sale but only to meet the actual requirements of the owners interested. Here the grass is first cut and subsequently cattle are let into graze, and in certain parts goats too are admitted. In addition the removal of litter is allowed. This is found to be the most advantageous method of treatment for the owning communities, as it satisfies their several requirements. Litter is essential for the cattle, as in such tracts no straw-yielding crops are grown. Indeed, here the land seems to be devoted to meadow and orchard culture with small patches of potato, beans and peas.

Under such a system, one is led to expect rapid deterioration of the soil. Such, however, does not appear to be the case. One such forest was visited in the community of Burglauenen in the valley of the Black Luetschine, just below Grindelwald and where there were *no obvious signs of degeneracy* Professor Vater, lecturer on *bodenkunde* (knowledge of soils) at the Tharandt Forest School whom I had the advantage of accompanying on this excursion, explained that this soil preservation had been observed elsewhere in similar situations, and that it is due to the constant weathering of rock above tree growth resulting in fertile detritus being washed down to refresh the soil.

The law gives power to bring pastures under forest where necessary (even when the property of private parties). Such conversion, as already explained, must first receive the sanction of higher authorities. It is, however, not incumbent on private owners to convert pasture into forest themselves, but should they refuse, the Cantonal authorities have recourse to compulsory acquisition. When it is necessary to fence in or drain pasture and private land, from 40 to 50 per cent of the expenditure incurred is borne by the State (in equal shares by the Canton and the Federation).

It is clear that, where denudation had progressed far, the measures detailed above were insufficient, and special works for the training of torrents and reclothing the slopes laid bare became imperative. These will be described later.

In the protective forests the sylvicultural treatment is entirely under the selection system. Only the largest trees are cut out. The selection of stems to be removed is solely guided by sylvicultural considerations, as influenced by local climatic conditions. The working plan does not fix any age or girth limit for the trees for removal, but there is a fixed maximum volume to be extracted. Valuations, by the usual methods, are repeated every 20 years, and the volume possibility of the working plan is altered accordingly where necessary.

The special climatic conditions to be considered are: hail which is frequent and violent, snow, heavy wind (specially in the valley of the Black Lactschine down which the *föhn* blows with great force) and the avalanches. The fact that the forest is intended primarily for the protection of the slopes is never to be lost sight of.

Natural regeneration of the indigenous species is ample and never fails. At certain points, however, where there is a deep layer (up to 20 inches) of raw humus, *Pinus Cembra* is found not to regenerate naturally, as the radicles of the seeds cannot penetrate to the subsoil.

When possible, felling is carried out in winter so that advantage can be taken of the snow to slide the timber down to the valley and to transport it on sleeges along the valley bottoms.

The principal dangers to be feared are climatic. Fire is rare and originates either through negligence or mischief by boys, or through sparks emitted by passing locomotives. In the latter case damages are obtained from the company owing the line.

Insects are not responsible for much damage. *Chermes abietis* is common, but the harm done is not important. In nurseries a considerable number of seedlings are destroyed by rock-cutting probably effected by *elaterid* larvæ.

Loss through fungoid parasites is also not extensive though considerably more so than that suffered through the depredation of insects. Many young plants of *Pinus Cembra* and silver fir are lost in the plantations through the attacks of *Herpotrichia nigra*, a fungus which spreads a filamentous mycelium over the needles and binds them together and to the soil. This fungus is always harmful in situations where snow lies long. The branches and often the whole plant is pressed down to the ground by the snow under the cover of which the parasite grows and spreads. When the snow melts the needles are found to be dead and the branches, and often the leading shoot, so firmly spun over and fastened down that they are unable to right themselves, and the whole plant perishes. Once the plant reaches 1½ to 2 feet in height it is only the lower branches that are damaged and the leading shoot remains untouched.

Trametes radiciperda at times causes loss.

Æcidium elatinum is frequent on silver fir where it induces a "witch's broom." The loss caused, however, is not of great importance.

Maples are badly attacked by *Rhytisma acerinum*, so that it is almost impossible to find a leaf undefiled by the black patches which reveal the presence of the parasite. The willows suffer also from *Rhytisma salicinum* as well as from *Melampsora spp.*

Alders are attacked by an *Exoascus (E. Alni-incanæ)* which deforms the fruit.

Chrysomyxa abietis and *Chry. rhododendri* are present. A *Coleosporium* was observed on the needles of silver fir. Other uredinous diseases on conifers must occur, though not actually

Photo.-Mech. Dept., Thomason College Roorkee. Photo. by H. Gabler, Interlake

Stream channel and wattle retaining walls.

observed on those hosts by me, as their alternate stages were seen on *Campanula, Senecio*, etc.

With the exception of the first named (*Herpotrichia nigra*) however, fungi though abundant and varied, cannot be deemed to cause any great actual loss at present.

The climatic dangers are :—

1. *Wind.* The *Föhn* wind from the south blows with extraordinary violence. In 1882 great damage was done by it in the Schwarzlaetschine valley. Whole slopes were laid bare. This proved not altogether an unmixed evil, as good excuse was accorded for the exclusion of goats, a measure already desirable before the calamity, and now partly by planting but also through self-sown seed these areas are reclothed with forest growth.

2. *Snow.* Heavy falls of snow are common and much damage is caused. In the current year, on the 23rd May, a fall of snow, unequalled for heaviness for 30 years past, took place and large numbers of trees were broken. Many young alders and beach have been permanently bent. These latter will be cut back for coppice in winter.

3. *Hail.* Fierce hail is experienced from time to time and this increases the damage caused by avalanches, torrents and landslips which are to be treated of below.

It has been observed, however, that a strip of forest on the ridge of a hill prevents hail from crossing. The Harder to the north of Interlaken has for this reason been planted up within recent years. A strip of forest is maintained on either side of the ridge and it has been observed that though hail is frequent on the northern slope and though it used once to cross over, since planting the southern aspect has practically become free of this scourge.

4. Avalanches are of frequent occurance in winter and early spring in the southern parts of the division. Along habitual avalanche tracks real forest growth is not possible, but broad leaved species are planted where feasible. These are repeatedly broken down but throw up fresh shoots from the roots. Such vegetation has of course but little effect on the avalanches themselves but

prevents the too rapid flow of water and obviates a certain amount of erosion of soil that would otherwise take place.

5. *Torrents.* Aggravated by the damage caused by goats about their sources, torrents became at many points a serious danger in these tracts.

The goats used to browse everywhere keeping down all vegetation and loosening the soil, which is then washed down by heavy rain, hail and melted snow. The banks become bare of vegetation and soon are denuded of soil, exposing the rock.

This devastation rapidly spreads till the torrent becomes what is locally known as a "*murgang*," *i.e.*, a stream of boulders and stones of small stability ever ready to descend under the influence of rain, hail or snow.

As already stated, the rock readily weathers into flakes and it is these flakes that constitute the loose *murgangs*.

Some 14 years ago the correction of these torrents was taken in hand and the success already effected is surprising. The Hautenenbach above Bönigen, which affords a good example of such works, was specially visited. Hautenenbach was a considerable torrent whose source, with that of its various affluents, arises on the slopes descending from the Schynige plateau and flows northwards into the lake of Brienz. The fall is from about 6,000 to 1,900 feet. Fifteen years ago not only was the fertility of the Bönigen fields threatened but also the safety of the village itself. (Bönigen is a village on the southern shore of the lake of Brienz about 2 miles east of Interlaken.)

The training and planting works have now completely set aside this danger, and stones are no longer washed down to the fields by the torrent, which, moreover, has regained the nature of a useful hill stream.

At first the correction of the torrent was attempted by merely constructing large retaining walls near the plain; but experience soon showed that all such works *are useless unless accompanied by similar erections right up to the sources.*

Starting therefore from the first beginnings of the rocky torrent bed, small cross-walls of stone are constructed at intervals,

gradually increasing in size and solidity to the bottom. These catch boulders rolling down and prevent their further descent. Where small stones only are to be apprehended the wall is built out from the ground level, but if large boulders may be expected the construction is raised in the form of a wall, the downward face being given a sufficient outward slope (Plate I. shows such a cross-wall).

The site of these retaining walls must be carefully selected. They should have rocks as "points d'appui" on either bank of the torrent and should also, wherever possible, be built upon rock in the stream bed. For the sake of economy as well as efficiency narrow places offering natural advantages, such as a point at which rocks just out from one or both banks, will be preferred.

It is obvious that such works, restricted to the beds of the torrents, cannot, by themselves, be sufficient or permanent. The result would merely be to force the torrent, in course of time, to form a new bed. It is necessary to fix the denuded and shifting slopes alongside and reclothe them with vegetation. For this purpose, across the bare scarps covered with loose stones retaining works are built at short intervals. In the higher reaches and where the sliding of small material alone has to be counteracted, these works take the shape of small paths or strips levelled along the contours. To give them somewhat greater permanence they may be planted with clumps of grass.

Below, as the unstable material increases in size and the denuded areas widen, the retaining walls are enlarged and made more solid. The flattened strip cut out of the slope is strengthened by laying slabs of stone flat along it and these again are supported and fixed in place by wooden stakes on the downward side.

As the necessity for massiveness increases stone walls are substituted of increasing size, or, where suitable boulders are not available on the spot, logs and posts are employed.

Once the shifting surface is brought to stability by these means soil gradually appears, washed down by rain and melted snow, and herbs begin to take root. It is surprising how soon such vegetation does come in once hospitality is offered it.

Where the slopes to be reclothed are not yet entirely denuded of soil, a simple and cheap method is to peg down at intervals leafy branches (specially of conifers) along contours. Also small wattle fences supported by staves are made use of.

The spaces between are planted with clumps of grass. Very soon more grass appears accompanied by numerous weeds. The first of the latter to appear is perhaps *Sedum annuum*. Among other weeds appearing early are *Adenostyles alpinum* (its leaves often orange with a parasitic fungus *Coleosporium cacaliæ* and other *Compositæ*, *Campanula cenisia* and later on *Parnassia palustris*, *Orchids*, Aconites (*Aconitum lycoctonum* and *A. napellus*) *Salvia glutinosa*, *Dipsacus*, other campanulas, gentians, etc

In the course of a couple of years the soil is fit for the planting of woody species.

On dry and very stony soil alders (*Alnus viridis* at the higher levels and *A. incana* and *glutinosa* below) and *Robinia pseudacacia* are put in.

With better soil *Pinus Cembra* and silver fir are mostly used. *Pinus pumilio* and *P. austriaca* have also been tried but without much success. The latter has the disadvantage of preventing the growth of grass and weeds beneath its shade and it is patent that no growth of any kind is to be discouraged in these situations. In this respect the alder is particularly recommendable.

Where the soil still remaining allows of it, the planting of woody growth proceeds simultaneously with the constructions of retaining works.

6. Landslips (*Bergsturze*). These are to a certain extent of the same nature as the denuded surroundings of untrained torrents. Through various causes the surface on precipitous slopes slips, laying large extents bare of turf and soil and eventually the underlying rock is exposed. Weathering goes on and rocks and stones continuously come hurtling down. Fields and habitations below are endangered and have to be abandoned unless timely steps are adopted. Many such places were to be met with a few years back along the Schwarzlutschine valley between Zweilutschinen (the junction between the Schwarz and Weisslutschinen some 6 or 7

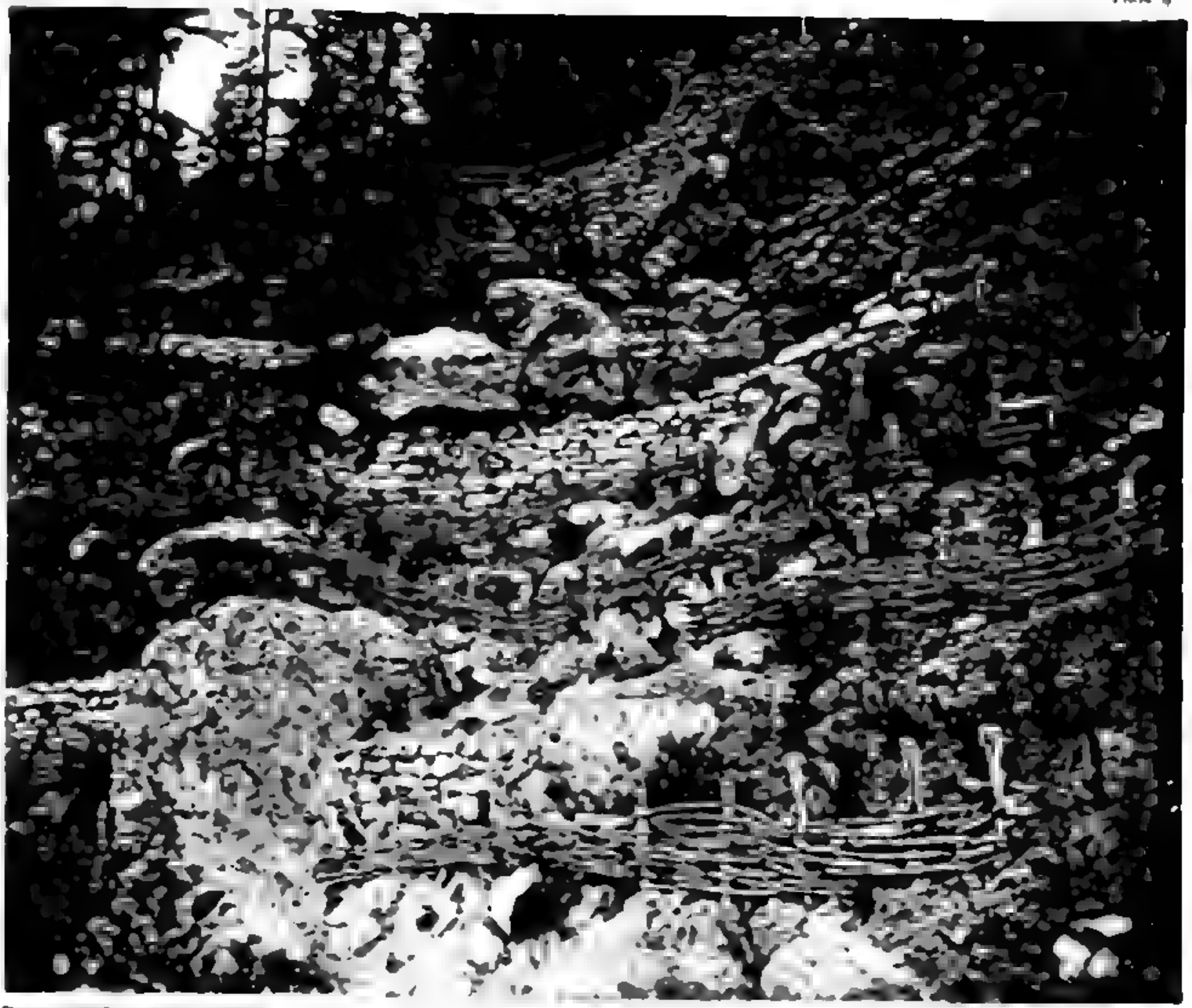

Photo. by R. Gabler, Interlaken.

Retaining walls of stone and wattle.

miles south of Interlaken) and Grindelwald. One large area damaged in this manner, overlooking the village Burglauenen was visited. Here some 2 or 3 springs appear half-way up the very steep slopes. It is thought that the slip was immediately occasioned by these springs, but as a result mainly of denudation caused higher up by goats. In any case, it is around these springs that the damage began and spread rapidly upwards and downwards, so that soon the whole slope was laid bare of soil and in motion with the usual flaky stones. So much debris was brought down with every fall of rain that a large cone (or "chine") was formed in the fields at the foot. The fields beyond were in danger and the few chalets at that points were threatened with destruction as also was the railway connecting Grindelwald with Interlaken. Some ten years ago the inhabitants of the chalets in peril were reluctantly about to abandon them when the remedial measures were taken in hand that have now proved completely successful.

Besides the rigid exclusion of goats, proper channels for the springs which started the slipping were dug out and paved (see Plates II and III). Near the sources the channels were lined with branches and then covered in with stones. Cross walls along contours were built at intervals from near the bottom to the top of the slip, to retain the moving surface (see Plate IV). At the top an extensive and solid revetment in steps, extending over a vertical distance of about 60 feet was built up of large stones. (This construction is well pictured in Plate V).

The intervals between the retaining walls were planted with *Alnus incana*, larch and silver fir and willow cuttings were put in. *Alnus glutinosa*, *Sorbus aria* and to a certain extent beech, have sprung up naturally.

Grass has of course come in and also a large number of weeds such as brambles, *Cirsium spp.*, *Vicia sylvatica*, *Campanula trachelium*, *Digitalis*, *Solanum*, etc.

The surface is now stable and no stones roll down.

Finally, below on the "chine" (*Kegelschutt*) side catch-walls were erected to retain the descending debris in a central channel

and the cone itself has become covered with a shrubby growth, mostly of alders.

The retaining cross-walls were taken well beyond the sides of the slip, so as to prevent further lateral erosion. To avoid expense, where the erosion had not yet become very severe, instead of stone walls, low wattle fences were tried and have proved successful.

The expense of these works has of course been considerable but not out of proportion to the inestimable benefits which have resulted. It would not serve any good purpose to quote details of expenditure here, nor would it have been easy to obtain averages, as the expenditure varies greatly according to the particular conditions of each work with reference to the extent of erosion that has to be remedied, the presence of suitable material for the stone work near the site, etc. It will perhaps suffice to mention that the current rate of wages is 30 to 40 centimes (2·85 to 3·84 annas) per hour, so that even the highest rate of wages for unskilled labour in India compares favourably.

As the community of Barglauenen (this name, by the way is derived from *Burg*, the name of the hill and *Lauenen*, a corruption of *Lawine*, which is German for avalanche) is a poor one, the cost was borne in the following proportions :—

By Cantonal funds	...	50 per cent.
By the *Alpengenossenschaft*	...	30 ,,
By the Railway Company	...	10 ,,
By the Community ...	...	10 ,,

No good photographs to illustrate the results of these works are available for the Barglauenen tract, but Plates VI and VII reproduce photographs taken from the same point at an interval of thirty-eight years. To fully appreciate the comparison it must be known, that the portions appearing light in the plates and showing deficiency in vegetation, are for the most part sheet rock incapable of supporting plant growth.

The plants required for planting in the various localities are raised in a series of small nurseries in the valleys near the rail line and the forests. Space was not available for a single large central

nursery, which would have been preferable, and so a number of small ones had to be established. In these, in addition to those required for the forests a certain number of plants for ornamental purposes are also grown and are sold to private parties or bodies or distributed to public places.

No special features deserving mention present themselves in these nurseries.

The plants are put out at the following ages:—

Larch at three years.

Silver fir and spruce at four years.

Pinus cembra at six years.

Broad-leaved species which are required to produce a good main stem, are kept rather longer in the nursery as experience shows that they become too branchy if put out at too early an age.

Planting is usually at intervals of about 4 feet.

I have not a wide enough acquaintance with different parts of India to indicate where similar works could beneficially be undertaken. It is pretty certain, however, that very favourable results could be obtained in many parts of the Himalayas and in the Western Ghats of the Bombay Presidency.

I have, unfortunately, never been privileged to see the Punjab *Chos*, but from what one reads, some such works would prove a great boon if not a real necessity.

In Southern India there are many denuded hill tracts which cry for such treatment. The greater difficulty would be due to the want of water and the probability of watering being necessary. There, however, wages are low, and what is possible in Switzerland is possible there too and the difference in wages would go towards the extra expenditure on watering. This could also be minimised by resting content with a covering of grass at first, allowing stronger growth to be brought in gradually. The grass could be sown instead of planted. If this suggestion were adopted it would be necessary to exclude all grazing, though cutting of grass could be allowed. When grown dense the grass would have to be protected against fire, as when burnt its protective power against erosion by rain is very greatly diminished.

There seems to be great scope in such schemes for famine works. The revetments, walls, drains, etc., being constructed during the time of famine and the planting and sowing being deferred till the drought has ceased.

The invaluable results of reclothing denuded areas with forest growth need no special stress at this date. Now-a-days every irrigation engineer will acclaim all efforts at placing or maintaining catchment areas under forest.

In conclusion, I would embrace this opportunity to express my gratitude to the Forest Officer of Interlaken, Herr Oberforster F. Marti, for his kindness in sparing me some of his valuable time, which he could ill afford, to show me the forests and interesting works under his charge. It is to his amiability that I am indebted for what of good this short report may contain.

C. E. C. FISCHER.

SOME STRIKING FACTS ABOUT MATCHES IN THE PHILIPPINES.

One of Japan's most profitable and thriving industries is the manufacture of matches. Japan's matches are sometimes made of paper and she exports over four million dollars worth of these little fire sticks every year. This is nearly three times the value of all the wood she exports and her wood industry is also profitable.

Japan supplies countries all over the world which are unable to make enough matches for themselves. America with her hundreds of factories cannot supply all her own demands herself. Americans alone use seven hundred billion matches a year. They pay more for their matches than any other country in the world. Japan, Germany, Austria and Sweden all help out in supplying the demand for matches made by the people of the United States.

Japan sends matches to the Philippines also; however, the Philippines have plenty of material and labour to make their own matches. The one match factory at Manila, the only one in the Philippines, takes care of 90 per cent of the trade of all the

Philippines. This factory is under European management and is an up to date institution, being installed with modern machinery using modern methods. The workers are all Filipinos.

The Filipinos are quick to learn how to operate intricate machinery, and like the Japanese take readily to work of this nature. Hundreds of men, women and children are employed in this factory and their work is altogether satisfactory.

The supply of match wood in the Philippines is also practically unlimited, but the difficulty lies in determining just what kinds of wood are best suited for matches and also in cutting wood enough to keep the factory running from day to day. The factory works up to the limit of wood it can get.

One might think that almost any kind of wood, or at least any part of the particular tree of the right kind, might be used in making matches. The reverse is the case. Only the choicest portions of particular trees can be used. Cross-grained timber or timber with knots cannot be used in the match industry. So it usually happens that a great deal of wood is left over. This in the Philippines is used for fuel to keep the factory running.

In America the cast-off timber of a match factory is utilised to make a number of by-products and the quarters where the matches are made are sometimes the smallest part of the factory. Doors, sashes, shingles, posts and laths are often made from the waste material.

Almost all of the wood that is used in Manila comes from Bataan province. This is near enough so that the wood can be floated directly over the bay to Manila. The wood is light and floats readily.

There is some waste in felling the logs, as the available machines for cutting the timber can handle only a certain size of log. Other machines will soon be installed capable of handling the largest logs.

There are three Philippine trees which have been found good for match material. They are—Taluto, Malapapaya and the Pincapincahan. The Bureau of Forestry is making continuous investigations and experiments to find other suitable trees. It is

thought that several more have been found recently that will answer the purpose.

When a tree is picked for the match manufacturer, it is felled and floated with others across Manila Bay and up the Pasig river to the suburb of Santa Ana. Here the match factory is located on the river bank. The logs are cut into short lengths or bolts and each made to turn on its axis by machinery and a shaving the thickness of the match desired is cut from the outer surface. Another part of the machinery meanwhile cuts the veneer into lengths and splits these into match sticks. Then the matches are dipped into a preparation and put into boxes when they are ready to ship.

Three hundred and sixty thousand boxes are gotten out every day in this manner. However, as many as four hundred thousand could be gotten out if the supply of wood kept coming in fast enough.

If matches could be exported from the Philippines, Japanese competition could be met. This is true notwithstanding the fact that the Japanese employed in the factories get only an average of eight cents (U. S. currency) a day's wage, while the Filipino gets from thirty to sixty cents a day. But the unlimited wood supply offered by the Philippine forests would help to make competition possible. In the Philippines where Japan matches are dutiable but still command a small market they would be entirely supplanted by the Philippine product.

China and Australia would also offer fine fields for an export trade from Manila, and should the lumber famine which threatens all wood manufacturers in the United States become a fact there also would be a field for the Philippine product.

MAURICE DUNLOP,
Collaborator, Bureau of Forestry,
Philippine Islands.

September 17th, 1908.

LAC IN THE EASTERN DUN, U. P.

The life history of the insect is now well known, but there are some facts I would place on record gleaned from investigations made personally in the Eastern Dun

In this locality there are two broods and the lac is collected during the first half of July and from the last week of October to the end of the first week of November. The young swarm generally by the end of the second week of July and of the first week in November, but the time of swarming varies considerably in different seasons. A good deal depends on the weather, for a normal season the broods swarm during the periods mentioned above, but should the season be a dry one and the rain hold off, the swarming will be delayed.

About six weeks to two months after swarming the males appear, but they are few in number in proportion to the females, so that in order to fertilise every cell, each ♂ must be able to impregnate 100 ♀. Males without wings are to be seen in both broods but are very scarce in proportion to the winged forms. It is erroneous to contend that one brood is winged, while the other is not.

The cells are attended by several species of ants, some of large size, and these swarm over the branches in myriads, but appear to do absolutely no damage to the insects. On the contrary they afford the cells a considerable amount of protection by attacking and driving off any insects that happen to alight on the branches. As a proof of my statement I would ask the reader to grasp a twig containing lac and note the behaviour of the ants. I think he would not care to repeat the experiment. It would serve no good purpose to attract the ants from the trees by placing something more toothsome at the roots, and the cost would probably take away all the profit. The presence of ants is an indication that the lac is healthy, and *vice versâ*.

The pests most to be feared are moths, and of these I have noticed species *Galeria* and *Eublema*. The larvæ of these are to be found in both broods and practically all the year round. There appear to be several generations of these moths in the year, for I have found larvæ in several stages of development as well as

pupæ in a single stick of lac and at different times of the year. In the first week of April I got a group of twelve white eggs, which were laid on the side of my rearing jar by a *Enblema sp.* moth which issued in the third week of March. A new species of *Ichneumon* fly has been reared from infested lac and has been sent to England to be named. This fly, it is hoped, is parasitic on the *Enblema sp.* The damage done by these moths is very considerable and I have known them to entirely destroy the cells on a tree These moth pests are certainly on the increase, and given favourable conditions they may entirely destroy the lac in a forest. The next greatest enemy to lac is frost. In the Dun lac is produced entirely on *B. frondosa* which is badly affected by frost, and almost all the tender twigs are killed by it during the winter, so that only one good crop can be expected annually. Fire does a great deal of damage, if the area is not carefully protected. Wind may do serious damage at the time of swarming, and violent wind is always harmful; a gentle breeze though greatly helps in the spreading of the young from tree to tree. In the case of drought, the insects may be killed at the time of swarming. Monkeys do not, as is supposed, eat the lac, but if they are watched it will be noticed that the damage done is only out of curiosity and wanton mischief.

At Pathri in the Saharanpur district there is a large forest area which is composed almost entirely of *B. frondosa*, which would yield a large quantity of lac were it taken in hand. Some experiments have lately been carried out by private individuals, but owing to the adverse conditions made by the Forest Department they have been compelled to abandon the experiments. One of the conditions laid down was that grazing be allowed, and this resulted in the forest being burnt and entailed a heavy loss on the experimenter.

Brood lac should be cut from the trees about a week before the swarming begins. In order to fix on the correct time it is only necessary to break open a few cells and examine them with an ordinary magnifying glass, when if the young can be clearly seen and if the colouring matter has become of the consistency of treacle, they are within a week of swarming.

When infesting trees, say, of an average height of 25 feet and well branched, it is sufficient to apply 4lbs of brood to each tree. The brood should be tied lightly in bundles, each bundle to contain three sticks, about a foot long. These bundles should be tied on the upper surfaces of the branches, and about three-fourths the way up and near the tender twigs. It is not of any advantage to use straw with the bundles, but care should be taken that the sticks of brood lac lie along the upper surfaces of the branches to which they are tied. The bundles of brood should be fixed by a tie at either end and not in the middle.

The lac from a *Ficus sp.* have been known to take splendidly on *B. frondosa*; and the *B. frondosa* lac young have been carried by the wind to the garden *lichi* tree and thrived so well as to necessitate the infested branches being cut in order to save the fruit.

On an average it costs Rs. 20 to produce a maund of lac and the price obtained varies from year to year. Last year Mr. Ollenbach got Rs. 80 per maund, and this was offered only Rs 25. The Indian markets offer very miserable rates, but a good price can generally be obtained from foreign countries.

G. N. GRAHAM YOUNG.

CURRENT LITERATURE.

THE INDIAN FOREST MEMOIRS, VOL. I, PART I (*Chemistry Series*).—This is the first number of the new series of Memoirs published by order of the Government of India. It consists of "A Note on the Analysis of Cutch and the Preparation of Pure Catechin" by Mr. Puran Singh, F.C.S., Acting Imperial Forest Chemist. The author states that the monograph embodies the results of an investigation which was undertaken with a view to improve the methods of analysis of cutch and the preparation of pure catechin. He claims that the proportions of tannin and catechin in cutch are the only factors which determine the character and value of this useful article, whether as a dye-stuff, a tan or a medicine. It follows that the importance of an accurate analysis of a sample of cutch can hardly be overrated. It is stated that our knowledge of the chemistry of catechin has hitherto been but superficial, chiefly owing to the fact that no method was yet known by which chemically pure catechin could be isolated in sufficiently large quantities for purposes of complete chemical investigation. The results of the present investigation are stated to have been very satisfactory so far as analysis of cutch is concerned. It is not claimed, however, that the method of obtaining chemically pure catechin as given in this Memoir is such as could be adopted by the India katha-maker, although, if purer catechin than hitherto sold in India could find a ready market here or elsewhere and fetch comparatively higher prices, there is little doubt that the method now suggested could be developed commercially so as to manufacture large and paying quantities of catechin. As cutch is loosing favour in the European markets owing, it is said, to the want of uniformity in the colour of materials dyed with it, it seems possible that such a demand will arise. Now, the author states that if catechin were removed from cutch, the latter would be much better for dyeing purposes and would consequently be better appreciated in European markets while the former freed from tannin would probably be more valuable as a medicine and as a masticatory and would fetch a high price both in India and elsewhere.

We are unable here to enter into details as to the investigations which have been made and must refer our readers who are interested in the subject to the Memoir itself. The Memoir is nicely printed in large type, it is quarto size and is illustrated by six excellent plates. We think Mr Puran Singh deserves great credit for the production.

MEMOIRS OF THE DEPARTMENT OF AGRICULTURE IN INDIA. *Entomological Series, Vol II, No. 6.*—In this the Cotton Leaf-roller (*Sylepta derogata*, Fabr) is described by H. Maxwell Lefroy, M A F E S., F Z.S , Imperial Entomologist. The author states that the account is published both as giving in some detail the life of one of the large class of leaf-rolling caterpillars and as giving full information regarding an insect that has in the past played a large part in checking the successful introduction of exotic cottons to India. The insect belongs to the family *Pyralidæ*. Details are given as to the description, distribution, life-history, hibernation, food-plants, destructiveness, checks, prevention and treatment. An excellent coloured plate illustrates all stages in the metamorphosis of this pest.

CANADIAN FORESTRY JOURNAL FOR JUNE 1908.—In an article entitled "Canada's Fertile Northland" some account is given of the facts elicited from the enquiries made in 1907 by the Select Committee of the Senate who were appointed to report as to the value of the dominion lying north of the Saskatchewan watershed and east of the Rocky Mountains. The evidence shows that there is a vast amount of valuable forest in these parts, though in many places much damage has been done by unrestricted fires. A paper by W H. Breithaupt on "River Regulation, with special Reference to the Ontario Peninsula and to the Grand River" is published, also a resolution by the Brantford Board of Trade petitioning the Provincial Government to investigate the entire subject of the conditions affecting the flow of water in the Grand River particularly and in other rivers generally. Floods due chiefly to the destruction of forests is one of the principal evils complained of. Roland D. Craig contributes a description of "The Timber Situation in British Columbia" and E. G. Joly de Lotbinière writes suggesting

"Compulsory Timber Reserves on Settlers' Lands." A valuable paper on "Tree Planting and Forest Preservation" by A. J. Ewart, F.L.S., Professor of Botany in the University of Melbourne, is reprinted.

FORESTRY QUARTERLY FOR SEPTEMBER 1908.—The number as usual teems with interesting matter. It opens with E. A. Sterling's article on "Artificial Reproduction of Forests." "Suggestions for the Handling of Pulpwood Lands in Eastern Canada" being a paper read by R. R. Bradley before the Canadian Forest Association is reproduced. B. E. Fernow contributes "The Results of Systematic Forest Management," while other articles are—"Forestry in Vermont" by L. R. Jones; "A New Use of Waste Products," describing a process for utilising all waste wood for the manufacture of pulp boards; "Mechanical Timber Estimator"; "On the Course of Prices in Forestry" by E. Bruncken, "The Light Requirements of Forest Trees and the Methods of Measuring Light" by Dr. C. Zederbaur, translated by R. Zon and B. T. Boisen, "Principles involved in Determining Forest Types" by R. Zon. A number of pages are devoted to "Current Literature," "Periodical Literature" and "News and Notes."

Space forbids our going into details of the matter given in this excellent Journal. We strongly advise our readers to subscribe to it. The price is 2 dollars a year, and as we have before pointed out it is the best professional Journal on the subject in the English language.

CONSERVATION, WOODS AND WATERS, SOILS AND ORES FOR SEPTEMBER 1908.—W. J. McGee, Erosion Expert, discourses on "The Cult of Conservation." C. H. Shinn continues his series on "Work on a National Forest"; this month his theme is chiefly concerning horses. J. L. Strobeck contributes "Forest Policy of Pennsylvania" Other articles are the "Nation's Need of Forestry Work" by Mrs. J. E. Mackisson, "The Nation's Herculean Task" being the synopsis of a lecture on the Panama Canal delivered by C. N. Bennett. The Appalachian National Forest Association recently founded for the express purpose of saving the remaining timbered slopes and watersheds in the Appalachian Mountains

announces that *conservation* has now become the official organ of the Association and a certain space will be allotted to the Association each month The magazine is full of interesting photos and various news items.

I

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE PATH OF THE CUCKOO.

Nearly a century and a half ago a Frenchman, named Lottinger, set himself to study the difficulties that beset the path of the cuckoo He undertook a series of experiments with a view to determining whether the small birds which act as "host' to the parasite readily accept eggs substituted for their own. In other words, he played the part of the cuckoo. He made some fifty attempts to induce wild birds to hatch out eggs other than their own, and every attempt ended in failure. To detail all his experiments would be wearisome in the extreme. The following six, selected at random, will suffice to give an idea of his methods and the results arrived at.

I. He placed the egg of a golden crested wren (*Regulus cristatus*) in the nest of the greater white throat (*Sylvia cinerea*), in which there were five nearly-incubated eggs. Within half an hour of being deposited the wren's egg disappeared. He next placed a thrush's egg in the same nest; this he found lying on the ground when he visited the nest the following day. He then substituted a blackbird's egg for the five whitethroat's eggs. Some minutes later he saw the whitethroat sitting on the nest, but the next day the bird had deserted and was busy building another nest.

II. In this experiment four out of five song thrush's eggs were removed. The hen forthwith deserted the nest.

III. Similarly, a greenfinch deserted the nest when her clutch of eggs was replaced by a blackbird's egg.

IV. Lottinger placed a song thrush's egg in a barn-owl's nest which contained three eggs. He found, six days later, that the owl had turned out the strange egg and was incubating her own.

V. He put the egg of a red-backed shrike (*Lanius collurio*) in a bullfinch's nest containing four eggs. A week later he found that the nest had been deserted and that it then held only the shrike's egg and one belonging to the bullfinch.

VI. In this experiment a woodlark (*Alauda arborea*) deserted the nest when her five eggs were replaced by an equal number of those of the greenfinch. Lottinger repeated many of his experiments using a pair of small tongs to place and replace the eggs, with similar results. It was thus evident that the desertion of the nest was not due to the fact that the eggs had come into contact with the experimenter's fingers.

The French naturalist came to the conclusion that every bird which has eggs in its nest deserts when these are exchanged for others by human agency, even though it has been incubating for several days, but that it is a very different matter when the cuckoo is the delinquent. His theory was it is not so much what the cuckoo does that should be marvelled at, as the way in which it does it. Otto, a German naturalist, confirmed many of the Frenchman's experiments. All this seems very conclusive. If we further consider the great variability of cuckoo's eggs, and the remarkable manner in which they frequently resemble those of the bird in whose nest they are deposited we seem compelled to believe that narrow is the path followed by the cuckoo.

It is, nevertheless, my opinion that this conclusion is erroneous. Birds are very easily imposed upon. It is well known that the common barn-door hen will, when possessed by the brooding fever, sit upon almost anything that even remotely resembles an egg. Turkeys have sometimes made gallant attempts to induce potatoes to yield young turkeys. Once a member of the gobbling community, whose eggs had been taken from under her, brooded a growing onion that projected above the level of the ground. When this was uprooted she sat for a couple of days on the hole left by it.

It must not be thought that these are cases of instinct having been perverted by domestication. The average wild bird will, when seized by the incubating mania, sit upon almost anything that finds its way into the nest.

Leverkuhn cites the case of a kite in the Zoological Gardens at Zittan, that laid 41 eggs between the years 1851 and 1868. For these, 69 hen's eggs were substituted, and no fewer than 53 were hatched out and the chicks reared.

Both the barn and the horned-owl have been made to hatch out fowl's eggs. During the past two years I have endeavoured to relieve the dullness of existence in India by collecting evidence of the easy manner in which birds can be duped.

The common crow of that country (*Corvus splendens*) has been the subject of most of my experiments. This bird is victimised by a cuckoo, called the Indian koel (*Eudynamis honorata*). I have successfully played cuckoo on several occasions.

From a crow's nest containing four eggs I removed two and replaced them by a couple of koel's eggs. The crow accepted the exchange, hatched out and reared the koels.

In another crow's nest I substituted a newly hatched koel for an egg. The crow at once accepted the exchange and successfully reared the koel.

In the same way, another crow continued to sit when I added to her clutch the greenish-blue egg of the paddy bird (*Ardeola grayii*).

On two occasions have I placed a fowl's egg in a crow's nest along with the eggs already in it. In neither case did the crows appear to notice the addition, although the fowl's egg was more than twice the size of their blue and brown ones. One of the fowl's eggs was thrown out of the nest by a mischievous boy on the twentieth day, when it had a fully formed chick inside. From the other, the chick emerged in due course. The crows were greatly scandalised when they saw it. There rage knew no bounds, they pecked at it so viciously that life was almost extinct before I could rescue the unfortunate creature. I have more than once induced a crow to sit upon a golf ball; but on the occasion when

I substituted four "Silvertowns" for a clutch of crow's eggs the owners deserted the nest.

When I put in a crow's nest an egg belonging to the common Myna (*Acridotheres tristis*) the crow sat upon it quite contentedly, although it is brilliant blue in colour and considerably smaller than the egg of the crow.

Last year, a pair of little brown doves (*Turtur cambayensis*) nested in the verandah of my office. I substituted a couple of pigeon's eggs for the legitimate ones. The exchange did not appear to be noticed. The baby pigeons eventually emerged and were fed by their foster parents, who showed no surprise when their white feathers appeared. Unfortunately the young pigeons were swept away in a cyclone while still unable to fly.

The little Indian sunbird (*Arachnechthra zeylonica*) that builds such a cosy ball-like nest, shows itself as ready as the crow to incubate strange eggs placed in its nest. It sat without demur on the egg of the Australia Zebra finch, a bird nearly as small as itself, also on the comparatively large egg of the common sparrow.

These facts seem to show that the path of the cuckoo is very smooth, that it is no great feat on the part of the parasite to make other birds hatch its eggs.

Did space permit I could cite many other instances which tend to prove that an incubating bird is to a large extent an automaton, a machine that will sit upon almost anything that is placed in its nest. One historic Calcutta kite spent several weeks in a vain attempt to induce a pill-box to yield a young kite!

It will be observed that my experiments have been with Indian birds. There is no reason to suppose that birds in England behave differently. I remember once adding a robin's egg to a clutch of blackbird's eggs. The hen blackbird continued to sit as though nothing unusual had happened. After a day or two I removed the robin's egg as it was a stale one My observations accord with those of Mr R. Kearton, who writes:—"I have often exchanged blackbird's eggs for those belonging to a song thrush and *vice versâ*, without any notice whatever being taken by either

species." He had some sham wooden eggs made and was able to induce blackbirds and warblers to sit upon these.

In face of these results what are we to think of those of M. Lottinger. One is almost inclined to hint that the nests he had under observation were tampered with by some mischievous person. It would be worth while for some English naturalist to repeat the experiments of the French savant and observe whether similar results are arrived at.—(D. D., *in the Indian Field*)

THE INDIAN GAME ACT.

REVISED DRAFT.

Sir Harold Stuart in circulating a revised Draft Bill for expression *of opinion makes the following observations* :—

The replies to the Home Department, letter No. 1082-90, dated the 23rd May 1904, with which a Draft Bill was circulated, disclosed a strong concensus of opinion in favour of protective legislation, while indicating a considerable divergence of opinion on the principles of the Bill. In the light of the criticisms offered, and after a careful consideration of the whole matter, the Government of India have arrived at the conclusion that the line of action originally contemplated should be undertaken to afford protection to those wild birds and animals which are threatened with extermination

A revised Draft Bill has accordingly been drawn up, and I am directed to circulate it for the further criticism and opinion of Local Governments. The revised Bill defines game and takes power for Local Governments to declare a close time during which it will be unlawful to capture, kill or deal in any specified kind of game or the plumage of any specified bird. Fish have been excluded from the scope of the proposed law, as their case can be suitably provided for by rules under the Indian Fisheries Act. The Bill also provides a general exception in favour of the capture or killing of game in self defence or in protection of crops or fruit and gives power to the Local Government to apply its provisions to birds other than those specified in the definition. It may be noted

that clause 3 corresponds substantially to clauses 5 and 7 of the original Bill, which were generally approved, and that clause 5 corresponds to clause 18 of that Bill, which also met with general approval. Clause 7 which applies only to birds is far less sweeping than clauses 2 (1) and 7 of the original Bill. In short, the present Bill embodies in an improved and simplified form those provisions of the original Bill which met with general acceptance. The Government of India consider that the proposed law will for the present be sufficient to restrict the indiscriminate slaughter of game, if it is combined with suitable restrictions imposed by rules under the Forest Acts in force in the different provinces.

The legislation comtemplated is likely to be of limited application, as it is probable that in many parts of India the protection afforded by forests to species threatened with extinction will make it unnecessary to apply the measure, should it be passed into law. It may, however, be argued that the proposed Bill, so far as it goes beyond the scope of the Wild Birds Protection Act, 1887, and especially in its application to deer and other animals which are liable to injure growing crops, is open to the objection stated in the Home Department, Resolution No. 1471-81, dated the 29th August 1885.

TEXT OF THE BILL.

The following is the text of the Bill :—

Whereas it is expedient to make better provision for the protection and preservation of game; it is hereby enacted as follows :—

Short title and extent.

1. (1) This Act may be called the Indian Game Act, 1908: and (2), it extends to the whole of British India, including British Baluchistan, the Santhal Parganas and the Pargana of Spiti.

Definition.

2. In this Act —"game" means all kinds of the following birds and animals when in their wild state, namely—

(i) bustards, ducks, floricans, geese, jungle-fowls, partridges, peafowl, pheasant, pigeons, quail, sand grouse, snipe, spur fowl and woodcock ;

(ii) antelopes, asses, bison, buffaloes, deer, gazelles, goats, hares, oxen, rhinoceroses and sheep.

Close time.

3. The Local Government may, by notification in the local official Gazette, declare any period of the year to be a close time for any specified kind of game throughout the whole or any parts of its territories; and during such period and within the areas specified in such declaration, it shall be unlawful—

(*a*) to capture or kill any such game;

(*b*) to deal in any such game;

(*c*) to deal in the plumage of any birds specified in such notification captured or killed during such close time.

Penalty for illegal capture or killing of, or dealing in game.

4. Whoever does, attempts to do, any act in contravention of section 3, shall be punishable

(*a*) on the first conviction, with fine which may extend to fifty rupees; and

(*b*) on the second conviction, with imprisonment for a term which may extend to one month, or with fine which may extend to one hundred rupees, or with both.

Presumption of commission of certain offences.

5. Where any person is found in possession of any game recently captured or killed, the Court may presume that he has captured or killed such game.

Saving.

6. Nothing in this Act shall be deemed to affect the capture or killing of game in self-defence, or in *boná fide* protection of a standing crop or growing fruit.

Application of Act to other birds.

7. The Local Government may, by notification in the local official Gazette, apply the provisions of this Act to any kind of bird other than those specified in section 2, which in its opinion it is desirable to preserve from extinction.

Repeal.

8. The Wild Birds Protection Act, 1887, XX of 1887, is hereby repealed.

THE AMERICAN BISON SOCIETY

A report of the American Bison Society, submitted by a correspondent of the *Times*, gives reasons for hoping that the largest and most picturesque of the North American fauna will not only be saved from extinction, but also enabled to increase and multiply until it can once more be classed in the category of big game. A census of living bison on the Continent shows there are 1,116 in more or less close captivity in the United States, and 476 such prisoners of civilisation in Canada. Of wild bison, there are about 300 in the latter country, and only 25 in the former, while the number of "cataloes" (a "portmanteau" word of obvious origin, connoting a cross between bison or "buffalo" and domestic cattle) in the two countries is estimated at 345

In some interesting notes on this census, Professor Hornaday makes the following observations: "The most important event of 1907 in the life-history of the American bison was the action of the Canadian Government in purchasing the entire Pablo Allard herd of 628 animals and transporting 398 of them to Elk Island Park in Canada. Inasmuch as it was impossible to induce the United States Government to purchase this herd and for ever maintain it on the Flathead reservation, the next best thing was that it should pass into the hands of the Canadian Government and be located on the upper half of the former range of the species. In view of the breaking up of the Flathead Indian reservation and its opening to settlement it was no longer possible for Mr. Pablo to maintain his herd either there or elsewhere The Canadian Government deserves to be sincerely congratulated upon its wisdom, its foresight, and its general enterprise in providing 157,000 dols. for the purchase of the Pablo herd in addition to the cost of transporting the animals and fencing Elk Island Park."

The remaining 230 bison on the Flathead range (which is in the State of Montana) are now being removed to their new habitation above the national boundary line. The transference has been carried out so far without loss, and the health of the animals—among whom the natural proportion of males and females has been maintained—has not been materially affected. A small herd

of 15 head lately increased to 17 by the birth of two healthy calves—has been established recently at the Wichita Reserve, and the cost of its maintenance has been defrayed by the American Government; but a proposal to form a New York State herd in the Adirondacks at a cost of 20,000 dols., though accepted by the two Houses of the State Legislature, was vetoed by the Governor on the grounds of the many demands on the Treasury and the doubtful success of the experiment.—(*Indian Field*.)

EXTRACTS FROM OFFICIAL PAPERS.

THE INDIAN FOREST SERVICE

New Regulations for the Indian Forest Service have recently been issued by the Secretary of State for India. Though the word "compromise" is written large on each page, the University of Cambridge may be congratulated on the result of the efforts made by its delegates, four years ago and more recently, to insist on the principle of open competition for this as for other branches of the Indian Civil Service. The regulations as they were published in 1905, after the removal of the Indian Forestry School from Coopers Hill, stood self-condemned. That the supply of candidates for an essentially scientific service should be made the monopoly of one University, even if that University were one endowed with the great traditions of Oxford, was an arrangement doomed to failure. According to those Regulations students trained in the Cambridge School of Science were, by the simple operation of an age limit, entirely excluded. Probationers were required to reside for at least two years at Oxford, and in addition to their University expenses had to provide for periods of maintenance and instruction in continental forests. The qualifying examination offered in no way a sufficient guarantee that the probationers had a thorough grounding in science such as to fit them to take up the special study of Forestry. For lack of candidates the requirement of even this examination and of

responsions or its equivalent was relaxed, and the list of probationers, to spend two years at Oxford, was filled up by "selection without examination." It is an open secret that the Forestry authorities in India had been for some time, before the removal of the Forestry School from Coopers Hill, less and less satisfied with the quality of the candidates sent out; and when, at the renewed request of the Cambridge authorities, the Secretary of State for India redeemed the pledge given by his predecessor in 1905 and, in April last held an enquiry into the working of the Regulations, a representative from the Forestry Department was brought home from India to sit on the Committee of Enquiry. We may assume then that the influence of this representative in no small degree coloured the recommendations of the Committee.

What then are the chief provisions of the new Regulations? How far do they represent concessions to the principle of open competition and to the views urged by the authorities at Cambridge? These were (1) that the competition should be open to graduates in science of all British Universities; (2) that consequently the age limit should be considerably raised; (3) that candidates after being accepted as probationers should be treated by the India Office as liberally as the selected candidates for the Indian Civil Service, and should have a grant-in-aid of their expenses during the probationary period; (4) that the home training should be confined to the general principles of Forestry, all specialisation being left to the completion of the probationary period in India itself. By the new Regulations then (1) the age limit for competition is raised to 23, (2) an inferior class of probationers may be admitted at the age of 19 and their period of probation to be spent at Oxford will extend over "about" three years; (3) in the case of probationers who have passed with honours in Natural Sciences the probationary period will extend over two years, (4) in case of those who have obtained a Diploma in Forestry, the period may be two years or less, as may be specially arranged; (5) the probationers will be required to undergo a special course of study at Oxford and to become members of the University if not so already; (6) an allowance of £120 annually, or

a total of £240, will be made to each probationer possessing a Degree in Natural Science or a Diploma in Forestry.

These regulations represent a great stride in advance of the old, but it is clear that they cannot be regarded as otherwise than purely temporary. We should be the last to deny that sound educational advantage may accrue from a period spent at a second University, and if that University is Oxford, no Cambridge man should grumble. But a post-graduate sojourn at another University should be essentially a period of advanced study or research in the strictest sense and not of mere qualification for an examination in no sense more advanced than that which he has passed at his own University. We cannot help thinking that the terms of the Regulations quoted above "two years or less, as may be specially arranged" indicate a speedy intention on the part of the India Office, so far as Cambridge is concerned, to reduce to zero the vexatious compulsion of residence at Oxford, and merely to require that probationers, if they have not done so already, should pay visits to continental forests under the guidance of the head of the Department.—*(The Cambridge Review.)*

THE DISTRICT FORESTS OF KUMAUN.

Extract from the speech of His Honour the Lieutenant Governor of the United Provinces, delivered at the Bareilly Darbar on the 2nd of November 1908.

* * * *

Another matter regarding which complaint is made is that the waste land in the Kumaun hills has been made protected forest. Land in the hills is divided into *nap, i.e.*, measured land, which is settled land and private property, and *be nap* or unmeasured land which, whether forest waste or broken up for cultivation is the property of the State. The reason why the Government some 15 years ago determined to bring the waste land in the hills under the protection afforded by the forest law was that wholesale and reckless destruction of the wooded area was proceeding rapidly all over the hills, and that, if the denudation of the hillsides had not

been checked, the injury done would have been incalculable and probably irremediable. It is hard to make it clear to the ignorant villager in Kumaun that the unrestricted cultivation of *khil, i e*, unterraced inferior land cultivated intermittently, does any harm to any one. He is never happier than when, hatchet in hand, he is felling trees in order to find a few square yards of land in which to sow *mandua* or *chua*. One cannot help sympathising with his desire to add to his small store of grain, but it is necessary to look beyond his immediate interests and to recognise that the continual denudation of the Himalayas must in the long run not only deprive the villagers of Kumaun of the forest produce of which they themselves stand in need, but also have the effect of rendering the rainfall over the plains of India still more precarious than it is now. Ample provision has been made for all the rights and concessions that the villagers can claim The Government has no desire to make money out of the forests and intends to spend on them, for the benefit of the people of Kumaun, the amount by which the receipts exceed the expenses But, in the interests of the residents both of Kumaun and of the plains, it is essential that no change should be made in the orders which have brought the waste lands under the Indian Forest Act.

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MISCELLANEA.

A FOREST TRAMWAY.

The wood roads serving the principal wooded area on the Roxburghe Estates being at all times bad and occasionally impassable, the question of how to improve them became imperative, in order that the annual fellings might be conveyed to the saw mill at a reasonable cost.

It was first decided to metal the existing rides, but as stones had to be hauled a distance of five miles, the cost for such a large undertaking promised to become prohibitive. The writer then

suggested a forest tramway, and after full consideration, this was sanctioned.

A brief comparison of the two systems of metalled road and tramway is as follows: A substantial metalled road for heavy traffic is expensive to make and maintain, especially when good stone cannot be got on the spot. The road is a permanent structure, which can only command a limited area, and in the case of a wood road is only used periodically and deteriorates during the periods of disuse. A light railway is less expensive to lay and maintain, requires less power to haul over, and, above all, is portable, and commands a circular area with its own length as radius.

The intermediate wood sleepers sawn out of tops were, on account of the soft nature of the ground, used to supplement the steel sleepers, with a view to easing the strain on the rails.

The track was laid in the dead of winter, during the shortest days, and with snow and frost to contend with. Had it been possible to do this in summer, the labour bill would have been reduced by one-third, as the men are paid at the same rate in summer as in winter. The convenience, however, of doing the work at that season outweighed all other considerations, and the advance in the price of iron subsequent to purchase probably makes the difference more apparent than real.

The bogies are hauled from the saw mill to the felling area by horse. The cuts, mostly 10 ft. and 18 ft., are hauled to the railway side, the heavier ones with their butts on a sledge and the lighter ones in the usual way. They are then loaded on to the bogies by skids, secured by chains and jacks, and returned to the saw mill one-third of the way by horse haulage and the remaining two-thirds down a declivity under control of the brakes and a rope.

The two sets of points are in use, one at the felling area to form a spur, and the other at the foot of the declivity and near the saw mill, as runaway points, to automatically switch the loaded bogies, in case of accident, into a sawdust heap.

On the average it costs 3*s.* per 100 quarter girth cubic feet to bring timber from the felling area to the saw mill by tramway. To cart the same quantity costs 6*s.* 3*d.*

One horse alone cannot keep the mill supplied by cart haulage, but by tramway one horse can easily do this in three days of each week. This leaves the horse available for other jobs on the remaining three days which taken by itself, is a great economy and convenience. (Mr. F. Moon, in the *Transactions of the Royal Scottish Arboricultural Society*.)

LEBANON CEDAR

Some few weeks ago, when reviewing the merits of various exhibits of woods at the Franco-British Exhibition, we conveyed some impression of the nature of the exhibits displayed, but in an unfinished state, and our attention was particularly drawn to the forestry portion of the Algerian Section, which is fitted with the Lebanon cedar. We noticed a handsome portico in arabesque style fitted with panels, specimens of parquetry, paving blocks, balusters, turnings, which ought to be of great interest to the building and joinery trade, while some furniture composed of wardrobe, bookcase, table, seats and chairs indicate its application to the cabinet-making industry. There have since been added further curious specimens showing the resistance of the wood to the action of extreme changes of temperature; there are also on show some pieces of old joists and beams which are indicated as having been employed for over half a century in brick-making and similar uses, and are said to have been almost constantly impregnated with water, the alternating periods being those of tropical heat, these appear to be wonderfully sound and almost free from usual defects consequent on such employment. There are likewise some old railway sleepers which have been used for over 30 years, and show practically none of the expected signs of ordinary decay. A further curious specimen shown is a piece of this cedar discovered among the charred remains of the old Roman city of Timgad, destroyed over 1,700 years ago, which also reveals a marvellous state of preservation.

Now that this wood is being imported into our markets in large quantities, it may be as well for the benefit of our readers to recall the fact that ancient history credits the Lebanon cedar with

a well deserved reputation. It is recorded as having been employed exclusively for the manufacture of doors and roofs, and it is said that this cedar (*Cedrus Libani, var Atlantica*), of which, according to Pliny, the beams of the Temple of Apollo at Utica were made, were found in the same state of preservation after 1,178 years as on the day they were erected

On account of the impression that the cedar forests of Lebanon have disappeared many years ago, the traditional existence of this wood has been practically relegated to the obscure sphere of archæology. However, there now appears to have been some considerable reserve of forests in the inaccessible portions of Algeria These have been of recent years opened up, and are now being seriously worked. We are told that in the mountain ranges of the district where it abounds nothing can equal the savage beauty of these clumps, which reach the highest summits of the locality. Everywhere can be seen magnificent trunks, crowned with a large table of foliage testifying to the age and vigour of these venerable trees, very many centuries old, giving an idea of the lasting qualities of the wood asserted as being almost eternal. The trees contain a particular resin which gives a penetrating characteristic smell. This agreeable odour keeps away all worms, moths vermin, rodents, etc., a precious quality no doubt from a commercial point of view, and for this, among other of the reasons given, it has been claimed that the ancients Greeks and Romans, as well as the Phœnicians and Egyptians, used to bury their illustrious dead in cedarwood coffins, and the coffins now to be seen at the British Museum containing the remains of the emperors, governors, and other celebrities of these remote periods, showing such marvellous state of preservation, are said to be of this remarkable wood

The fineness of its grain corresponds admirably with the various adaptations common in carpentering, upholstery, sculpture, and for polishing and mouldings. The regularity of its veins makes it invaluable for the manufacture of select furniture. There is no doubt that now this wood is known and appreciated to its full value its use will become more and more general.—(*Timber Trades Journal.*)

CAMPHOR IN CEYLON.

The United States Vice Consul at Colombo says that an early and appreciable contribution to the world's supply of camphor is promised as the result of recent planting operations in Ceylon. In 1907 the camphor acreage of the island was increased from 142 to 1,106, and the indications are that the new acreage of 1908 will be even greater. "Camphor-planting," he continues, "has been stimulated by the high price of the drug and by the successful *results of experimental planting. While camphor will not grow* at sea-level in Ceylon, it finds congenial conditions in the mountainous parts of the island, and thrives finely at elevations of from 2,500 to 8,000 feet. The situation is so favourable to its profitable production that enthusiastic planters entertain the belief that Ceylon in a few years will produce camphor in a quantity greater than the world's present demand. It is estimated that the planting of between 15,000 and 20,000 acres in Ceylon would develop a production of 8,000,000 pounds, which, according to most authorities, is the quantity of camphor demanded annually at present. The rapid growth of the twigs and the cheapness of land and labour are the factors depended upon by planters to give Ceylon an advantage over other camphor-producing countries. The figures given by planters to represent the cost of a pound of Ceylon camphor are much below the figure representing the reputed cost of synthetic camphor produced in the United States from turpentine oil." —(*The Pioneer.*)

SCHEME FOR ESTABLISHING A NATIONAL INDUSTRY OF FORESTRY.

Proprietors as a class seem now to be sufficiently awake to the profit and advantage to be derived from a well-considered scheme of sylviculture, but nevertheless we see throughout Scotland very little evidence of any general development of what may be called commercial planting. There are few proprietors of large estates interested in their improvement who cannot point out considerable parts of their property which might profitably be

devoted to growing timber, without material injury to the farms but with advantage to the rest of the estate, through giving shelter and adding beauty. Some proprietors will add the remark that they would rather have trees to deal with than tenants. The former never grumble—if they have complaints they keep them to themselves; there is no fear of their agitating for troublesome legislation; and if there is too big a stock of game, no ill-feeling is bred.

Why is it that so little commercial *planting is being done in* Scotland in spite of these advantages in the eyes of the landlord and in spite of the small net return now to be got from farming land of inferior quality? The reason is not far to seek. There are few proprietors who can afford to sink capital in planting, and fewer still who, if they can afford it, are inclined to part with their money in the certainty that they will get little or none of it back however great may be the return to their successors at some remote date.

Nor can we wonder. Few proprietors who have money in addition to land will incline to reduce their incomes for the rest of their lives by investing it in a private enterprise which cannot possibly yield them any return; and fewer of those who have land and no money will choose to burden themselves with the interest charges and expenses which will be the only outcome to them of sinking a large sum in planting—for commercial planting can only really be successful on large areas of ground, even if the plantations are gradually formed. Indeed, it might, in *many cases, be rather* an additional burden than a relief, that the money expended in planting would have to be borrowed in instalments. Apart from the interest charges, a hard-up laird will consider that he will lose some income from loss of rent for the planted land, even though the land be poor and the rent small.

All these circumstances lead to the conclusion that if commercial planting is to be seriously developed in this country, some furthering scheme of finance must be devised. Government loans at once suggest themselves, as they do in the case of most well-intentioned schemes that cannot quite stand on their own legs.

If one regards this scheme as for the benefit of the public, and specially for the benefit of the working classes in developing a great industry which will employ labour in the most healthful conditions, it seems a clear case for opening the nation's purse. But in these days of dear money and national economy, with heavy demands for educational and other public purposes, Government money is extremely difficult to get, and, if it is obtainable, it must be on terms that will strongly tempt the Chancellor of the Exchequer to loose the strings of the nation's purse. Can such terms be proposed? To answer that question is the purpose of this paper.

To tempt the Government successfully, two conditions must, if possible, be attainable (1) Immediate and substantial public advantage through the expenditure of the money provided; and (2) ultimate financial success, and the return of the money to the nation's coffers with a sufficient interest or profit.

The first condition should not be difficult to fulfil. Any commercial planting scheme should be carried out gradually, the area to be ultimately dealt with should be large, and there should be regularity in the extent planted each year. This means steady and continuous work for those employed in planting up the land and managing the woods, over a long series of years, even though the work may only cover a portion of each year. Following the correct modern system of sylviculture, a definite plan or course of cropping should be followed, under which the plantations will come to maturity as far as possible in regular divisions. Under this system the areas will be planted in regular and equal divisions, and the intermediate thinning operations will likewise fail to be carried out in equal and consecutive parts. Thus the forest work should be regular and constant in quantity each year, and its amount should steadily increase. To commence with, a definite acreage would be fenced off, prepared and planted each year, and in connection with this a definite and regular amount of nursery work is required in growing the seedlings to supply the plants. After a few years the first planted division will be ready for thinning, and continuously thereafter this work will be added to the planting.

Ultimately the cutting operations will be added, division by division. Thus it will be seen that a steady and increasing amount of labour will be called for year by year, until the entire forest has been fully constituted. It will be noticed that while those different operations can be carried on at different times, most of the work falls to be done in the winter months. This suggests the suitability of combining the forest work with agricultural employment, the later work being more constant in the spring, summer, and autumn months, and the possibility of connecting with such a scheme of commercial planting, small agricultural holdings to be let to employés with enough land to keep them employed at such times as the forest does not require their labours. This, too, would help to spread the work provided over a larger number of men, and there can be no doubt that ordinary agriculture and forestry are sufficiently kindred employments to let a man be good at both, and that in most forestry work there is sufficient elasticity as to times and seasons to allow successful farm work to be carried on alongside.—(*Transactions of the Royal Scottish Arboricultural Society.*)

AFFORESTATION.

The Royal Commission on Coast Erosion took further evidence in London in September on the subject of tree-planting as a remedy for unemployment. Mr. Ivor Guest presided.

Mr. Alderman J. Roberts, ex-chairman of the Denbighshire County Council, described afforestation as beneficial to farming operations in upland districts. Where it was sheltered by plantations, corn grew better and ripened sooner, and cattle thrived better and the grazing season was extended where shelter belts were judiciously established. Afforestation would keep the labourer and his children on the land, and would arrest migration from the rural districts to the towns. He thought there would be a difficulty in buying up common rights for the purpose of afforestation.

Mr. D. F. Mackenzie, Morton Hall, Midlothian, said land under trees in Scotland would produce 10*s.* per acre per annum,

against a return of $3\frac{1}{2}d$. per acre per annum on land now let for grazing purposes. There were six million acres in Scotland which could be put under trees at a cost of £36,000,000, and the value of the timber when grown he estimated at £930,000,000. In fifty years home-grown timber would be 50 per cent. dearer. Home grown timber was much tougher, lasted longer, and stood the breaking strain better than the foreign product. He was in favour of growing railway timber. He thought timber would relieve the congestion of the labour market, and where planting was remote from the towns he would build cabins for the labourers. The Commission adjourned.

It is anticipated that the Royal Commission's report on afforestation will recommend an important national scheme, and that the Government will early proceed to give effect to it in order to find work for the unemployed. -(*Timber Trades Journal*)

NOTES.

Forest Officers' Pensions. —It is notified that Conservators of Forests, who have rendered effective service for three years in any grade, provided they have shown special energy and efficiency, are eligible for extra pension of Rs. 1,000. This is subject to the condition that if a Conservator has served only in the second or third grade, he must have completed 28 years' total qualifying service. The orders with reference to this matter will have effect from the 27th September last.

We hear a rumour to the effect that the above restriction was made by the Government of India. We therefore take this opportunity of stating that the Secretary of State in according his sanction definitely imposed this condition, saying he was unable to acquiesce in officers being able to earn the normal and extra pensions on the same date.

Powers of Conservators in the U.P.—An important G. O. has recently been issued in the U. P. delegating to Conservators

powers to arrange, after mutual consultation if necessary, the postings and transfers of Gazetted Officers of the Forest Department.

Board of Scientific Advice for India.—We are glad to learn that the subjects under investigation have been altered so as to give due prominence to Forestry. Formerly there were only three Forest subjects, *viz.*, Forest Botany and Forest Products under the main head Botany and Forest Entomology under the main head Zoology. Now Forest Chemistry and Forestry have been added as main heads with Sylviculture and Forest Products as sub-heads of the latter. At the same time the sub head Forest Products under Botany has been discontinued.

Photographic Outfits. A recent circular of the Inspector-General of Forests intimates that photographic outfits will no longer be available on loan from the Forest College, and suggests that it would probably prove advantageous if each circle were to keep at least one camera in stock since the value of photographic records for exhibiting the progress in Sylviculture and research and in many other ways as an aid to Forestry is fully established

Stebbing's 'Manual of Zoology.'—The price of this manual has been reduced from Rs. 10 to Rs. 5 in the case of (*a*) Officers of the Forest Department below the rank of Extra Deputy Conservators of Forests, (*b*) students of the Imperial Forest College, Dehra Dun, provided that no officer or student may purchase more than one copy at the reduced price. The book may be obtained from the Superintendent of Government Printing, India, Calcutta, or from the agents for the sale of books published by him.

Exports of Cutch.—We learn from *Capital* that the exports of cutch from India have materially declined; in the five years ending with 1891 92, the average annual shipments were 227,900 cwts. valued at Rs. 35,26,440 as against 79,429 cwts. valued at Rs. 13,48,391 in the five years ending 1906-07

Photo. Mechl. Dept., Thomason College, Roorkee. Photo by R. Gabler, Interlaken.

Big revetment at top of landslip on Burglauenen.

VOLUME XXXV NUMBER 2

INDIAN FORESTER

FEBRUARY, 1909.

THE STATUS OF THE FOREST OFFICER

The status of the Forest Department or of the Forest Officer, that is the estimation in which these are held in public opinion, is a subject which has almost continuously been before those who have taken a great interest in Indian State Forestry

And this is but natural. For public opinion must always be to a great extent a guide to those responsible for the administration of the country and public criticism a wholesome incentive to individual work; needless to say that both opinion and criticism become more effective as a knowledge of the subject becomes wider spread or to add that in India this knowledge has increased rapidly during the past few years, so that the Indian Press has now made State Forestry its own as much as any other branch of practical politics.

The late Sir Dietrich Brandis was amongst the most insistent on the subject of the improvement of the status of the Forest Officer His model, and perhaps rightly so, was the Indian Civil Servant under whom the Forest Officer works, and he used every endeavour notably, in the matter of assimilating the language tests for both

services, in order to bring about his object. But he and his successors overlooked one important point, namely, that social and official status are in India to a great degree interdependent and that it is difficult to raise either without in some degree approximating the conditions of training and service obtaining in the two branches of administration. The attempt to impose sterner tests on a service badly paid and not to be entered without a long and expensive probationership could but accentuate the distress and discontent already existing, and it might have been obvious that until these disabilities were removed there could be little hope that those already in the Department would be able to appreciate a policy theoretically unimpeachable or that future entrants would disinterestedly labour and travail towards the attainment of so difficult and unremunerative a goal.

At the present time however conditions are different. The elevation of the social status of the Forest Officer is being achieved first by the improvement of his pay and prospects in India, and second by the improved standard of recruitment which has been imposed in the Regulations of 1909. With regard to the former the change constitutes a tardy act of justice in return for the devotion to duty of a Department which had created so valuable a State property for the Empire, and with reference to the latter it is evident that the Home authorities are now willing to shorten the period of probation and to reduce its expense provided that suitable candidates for appointment are forthcoming—men who, it will be observed, will come from the same Universities as the members of the I. C. S. with at least as high honours, and who will be able to take their place before the public with the hall-mark of knowledge acquired under the best social conditions, in fact with a similar training to that of those officials with whom they are in daily contact.

This is an immense step in advance, but there are yet other two points of importance for consideration, namely, the attitude of Government and the attitude of Forest Officers themselves towards the Department. The first can be dismissed in a few words with the remark that if in the past the importance of the Indian

forests has been underrated and if in consequence public recognition of the services of the Forest Officer has been meagre in the extreme, there has been also evidence of late years of an awakening to the fact that the forests of the country are indispensable to the progress of its industries, and this must bring with it a more sympathetic consideration of the work of the Forest Officer and therefore of his claims, equally with other perhaps up till now better known departments, to rewards for special merit which most effectually serve to regulate public opinion in a manner most desirable for the steady development of Indian State Forestry.

The attitude of the Forest Officer to his Department is a matter not so easily disposed of. The vacillations in the system of forestry education of the past 40 years must have some influence on the constitution of the service. We have oscillated between competitive examinations followed by practical training in continental forests, to a collegiate probationership with longer or shorter continental residence from selected candidates who are expected to take a University course and continental residence in sequence, and we have now arrived at what may be expected to be a haven of rest where Forestry as a science is to form part of the higher education of our recruits with practical examples afforded in European forests. But the material so collected is not homogeneous and conduces little to similarity of method of thought or even to a true departmental *esprit de corps*. Yet one object should bind us in common. To raise the Imperial Forest Officer from being what he too often is, a mere executive drudge, to the position due to his educational status and ability; to insist that his duties consist in administering forest policy and directing sylviculture and in guiding his subordinates in carrying out that method of management and those improvements which his superior abilities and scientific attainments convince him are suitable to the area in his charge. Provided that opportunity be given, as it undoubtedly will be, it rests with the members of the Forest Service to see that the recruit enters upon his life's work with, at any rate, some knowledge of the conditions which regulate it; that he subsequently passes rapidly through the routine work of the Indian

forests, such as markings, fellings, timber measurements which vary only in detail from those he is already acquainted with so that he may be able promptly to take his proper place in the scheme of administration in charge of forests of importance where he can utilise the special training he has had and thus gain daily in experience by contact with the people and in enlarged acquaintance with their requirements and with the consequent treatment of the public forests. If the departmental status of the Forest Officer is to be raised in the same degree as opportunity has now been afforded to raise his social status, we must have no more long continued routine drudgery, no more small divisions held one day by an Imperial Officer and the next, perhaps, by a member of the Upper Subordinate Service; we must recognise that the Imperial Officer is a scientist, give him scope to prove his ability and to utilise his attainments, so that from the outset of his career he may be unhampered by unnecessary interference and realise that his future is in his own hands and that it will depend entirely on his own exertions whether or not he makes a name in the profession he has selected.

SCIENTIFIC PAPERS.

THE FUTURE OF CUTCH AND KATHA MANUFACTURE.*

INTRODUCTION.

Catechu is of two kinds (1) dark catechu, or cutch used as a dye stuff in industries, and (2) pale catechu or Katha, a grey crystalline substance used in medicine and eaten by the natives of India in *pan*. Both these substances are derived from the wood of *Acacia Catechu*. During an investigation which was recently undertaken by me into the methods of cutch analysis, some important facts were brought out concerning catechin, the crystalline active astringent principle of Katha. These facts have a direct bearing on the future developments of the catechu industry and

* This paper was read by Mr. Puran Singh at the Punjab Forest Conference at Lahore in January 1908.

towards the end of my "Note on Cutch Analysis and Preparation of Pure Catechin,"* which embodies the results of the above-mentioned investigation, I have briefly hinted as to how the manufacture of Katha could be improved. I have also written a note on the utilisation of Assam Khair forests.† Reference is made to both these Government publications in the body of this paper and those interested in the subject may read them also perhaps with profit. The object of the present paper is to discuss more fully the bearing of the results of my investigation on the future of Katha manufacture. It is proposed to review briefly first the native crude methods of manufacturing Katha and cutch and the suggestions made by previous investigators to improve their manufacture, and finally to consider the means by which the proposed scientific methods can be made an economic success.

COMPOSITION OF KATHA AND CUTCH.

It is not proposed to enter here into the chemistry of catechu and its constituents. But before proceeding to discuss the methods of preparing cutch and Katha, it seems desirable, for an intelligent understanding of the particulars connected with their manufacture, to give here the important properties of the chief constituents of catechu and to make a distinction between cutch and Katha from the chemical standpoint. As said above, both cutch and Katha are obtained from the wood of *Acacia Catechu*. Both contain as their active astringent principles catechin, a colourless crystallisable substance soluble in hot but practically insoluble in cold water, and catechu-tannin, a non-crystallisable tanning substance soluble in water of all temperatures. Thus, so far as their qualitative composition is concerned, both cutch and Katha are similar substances. As regards their quantitative composition, however, they are found to be widely differing from each other. Analysis shows that in Katha the proportion of catechin outweighs by far that of catechu-tannin, so that Katha in its purest

* *vide* The Indian Forest Memoirs, Vol. I, Part I (Chemistry Series).

† *vide* Forest Pamphlet No. I (Chemistry Series).

state consists mostly of catechin, while in cutch exactly the reverse is the case, so that all good cutches like those exported from Burma consist mostly of catechu tannin with but a small proportion of catechin.

Crystalline catechin is a very delicate substance and undergoes speedy decomposition in its solution of hot water. The decomposition product of catechin is catechu-tannin, and change of the former into the latter, it has been established beyond doubt, is an oxidation process. Catechu-tannin, on the other hand, is a much more stable substance and is unaffected by boiling water. On very long standing with boiling water, however, it is probable that it gets more or less oxidised when its value as a dye is lowered. On boiling with potassium bichromate solution, it is easily oxidised into a complex substance about which nothing is known except that, when fixed on cotton fabrics, it imparts to them a dark or reddish brown colour which is fast to washing and to acids. The inference is thus easily drawn that catechu-tannin is an intermediate product between catechin and the last mentioned insoluble substance which has provisionally been termed *Japonic acid.*

THE PRESENT METHODS OF CUTCH AND KATHA MANUFACTURE.

1. *Manufacture of cutch*—The processes of boiling cutch as practised in different localities in India where it is manufactured, though varying more or less in minor details, are identical in principle. The method as practised by the Burma cutch manufacturers is as follows :—

The heartwood of the tree is first cut up into small chips. These are then boiled with a large quantity of water in earthenware pots of three or four gallons' capacity for twelve hours. The chips are then removed and the extract is transferred to a large iron cauldron of about twelve gallons' capacity and boiled down with constant stirring to syrupy consistence. The cauldron is then removed from the fire and its contents constantly stirred with a flat paddle-shaped piece of wood to prevent the formation of skin on the surface of the hot viscous liquid. When the mass is cool enough to be handled, it is transferred into brick-shaped moulds

lined with leaves and left overnight to dry. In the morning it is ready for the market.

2. *Katha manufacture.*—Katha is used in *pan* all over India, and it is believed that in many places it is made by refining the dark catechu by crystallisation with hot water. In Kumaon, however, it is directly manufactured from the wood of *Acacia Catechu.* It is reported that the Kumaon *Khairas* (Katha boilers) first cut into the heartwood of the standing trees for the purpose of examining whether or not they contain "white spots." The trees without "white spots" in their heartwood are rejected, and those only which show "white spots" are regarded as suitable for Katha manufacture and accordingly felled. These latter, after the sap wood is removed from them, are cut up into small chips which are boiled with water. The decoction is then concentrated, a bunch of twigs is thrown into the hot liquor to assist the crystallisation of Katha and the pots set aside to cool. The twigs are finally taken out and the Katha adhering to them is collected, compressed into cubes and dried. Some reports state that when evaporation is going on, the liquid is stirred with sticks dipped in castor oil to prevent frothing and no twigs are used to assist crystallisation. The concentrated liquor on cooling is poured on sand when the crystallising Katha remains above and is dried, and the non-crystallising portion of the extract soaks away into the sand.

DR. WARTH'S SUGGESTIONS FOR IMPROVED MANUFACTURE OF CUTCH AND KATHA.

The above methods of cutch and Katha manufacture, as pointed out by Dr Warth, are very wasteful and destructive. In manufacture of cutch practically the whole of the catechin is destroyed, while in the manufacture of Katha the tannin is irreparably lost. Dr. Warth recommended the following method for the combined manufacture of cutch and Katha:—The finely-cut wood is first boiled with twenty times its weight of water, the decoction is separated from the wood by repeated settlement and then concentrated over fire until it just begins to thicken or form skin on the surface. It is then left to stand in a cool place for five days,

during which period catechin crystallises out. This catechin which is very pure Katha is then filtered off and dried at a low temperature. The filtrate is utilised for the manufacture of cutch for the European market.

To make the combined manufacture of cutch and Katha a commercial success, Dr. Warth proposed to establish a Government Central Factory where improved appliances could be used instead of very primitive ones in use at present. He showed that a great saving could be effected by cutting the wood with machinery at such a central factory, but he does not appear to have taken into account, as was afterwards pointed out, the expenses of transporting to the factory the bulky logs from different places.

After the concentrated decoction has stood for five days, it is extremely difficult to separate the crystallised catechin from the strong tannin solution through ordinary filters. Dilution with water facilitates the process of filtration, but it is not advisable as it causes loss of catechin. The native method of filtering through sand is very crude and wasteful. In the first place, much of the sand gets mixed up with Katha, and secondly the tannin which soaks away into the sand cannot be recovered. For this wasteful method of filtering, Dr. Warth recommended the substitution of filter presses by the aid of which the separation of catechin from the tannin would be not only perfect but rapid.

As regards the evaporation of the filtrate from raw catechin or Katha for the preparation of tannin or cutch for the European market, it was recommended that this should be done in vacuum pans. The ordinary way of boiling under atmospheric pressure not only requires many hours of stirring and beating the extract but according to Dr. Warth spoils more or less of the catechu-tannin.

There remain only two more recommendations of Dr. Warth to be mentioned. One of these relates to the use of iron vessels in the extraction of catechin. Dr. Warth found that iron had very injurious action on catechin and so recommended that copper cauldrons should invariably be used instead of iron vessels in the manufacture of Katha. The other recommendation of this investigator is about the selection of trees for the manufacture of Katha.

He strongly deprecates the native system of rejecting all trees the heartwood of which shows no white spots as unsuitable for Katha manufacture. The spotted wood no doubt yields more extract and more catechin than the unspotted wood, but considering that the smaller yield of catechin from the latter would be compensated for by the manufacture of cutch, Dr. Warth recommends that the wood of all trees whether with or without spots should be utilised for the manufacture of Katha and cutch.

DR. LEATHER'S RESEARCHES.

After Dr. Warth the enquiry into the subject of separation of catechin from tannin was taken up by Dr. Leather, Agricultural Chemist to the Government of India. His experiments along with Dr. Warth's are fully recorded in the Agricultural Ledger No 1 of 1895. Here I shall give only a brief summary of the conclusions arrived at by him. He experimented on the form in which the wood should be used, on the effects of soft and hard waters, the amount of water required and the time necessary to extract the wood. The results of these experiments led him to make the following recommendations regarding the process of extraction of the wood :—

1. The wood should be reduced to thin shavings with the carpenter's plane, as when the wood is used in that form, the water can easily enter the cells so that the whole of the catechin and catechu tannin can be brought into solution in shorter time.

2. Both hard and soft waters may be used, as it is immaterial to the process of extraction whether the water used be soft or hard.

3. As little water as possible should be used for extracting wood. Ten parts or even less of water to one of wood would quite suffice for exhausting all soluble matter present in the wood

4. The extraction of the wood at the boil should be continued for half an hour only.

A CRITICAL EXAMINATION OF THE ABOVE SUGGESTIONS

If we could not devise a new method for the separation of catechin from the wood of *Acacia Catechu*, the method of extracting the former by means of hot water was the only one that could

be used and it would be impossible to improve any further manufacture of Katha by this method than has been done by Dr. Warth and Dr. Leather. Dr. Warth's proposal to form a central factory was not entertained by the Government for many reasons. As regards the recommendations of Dr. Leather, they are really *of great practical value in the manufacture of Katha, as they aim* at effecting not only financial economy but a considerable reduction in the loss of catechin; but I do not know if they have been adopted anywhere in India.

It appears to me that the Pegu system of cutch boiling, as described in the beginning of this paper is almost perfect with regard to the manufacture of catechu for industrial purposes. The Burma manufacturer's object is to make cutch and not Katha. Thus his boiling the wood with a large quantity of water for several hours before, and his continued stirring the liquid after, the final drying of the extract, may be regarded as purposeful, inasmuch as these processes serve in the conversion by atmospheric oxidation of most of the catechin present in the extract into catechu tannin. This, I believe, is the reason why the cutch worker cannot be induced to accept the suggestions regarding the *amount of water, the duration of boiling* and the use of vacuum pans for the final evaporation of the extract. There is no doubt, however, that since he prepares his cutch by destroying the valuable catechin, it is extremely desirable that he should be taught the advantage of separating catechin as far as possible from the extract, and instructed about his extravagance of both labour and money spent in converting the more valuable into a less valuable substance. The advantage of separating crude catechin or Katha from cutch is undoubtedly great. In the first place, Katha, being a valuable article of daily use among the majority of Indians, can be sold by itself and fetches a higher price than cutch. Secondly as I have shown elsewhere in my note on cutch analysis by reference to the investigations of Professor Hummel and Mr. Brown and to the defects of Indian catechu as a dye, the separation of catechin from cutch greatly enhances the value of the latter as a *dyeing agent*.

The above mentioned suggestions for the improved manufacture of Katha and cutch aim at making the separation of catechin from cutch a commercial success. The adoption of these by the Kumaon Katha workers would no doubt result in the increase of the yield of Katha from the trees of the Oudh forests; but I am not sure that the extraction of catechin through their means from the wood of the Burma trees or from the variety of *Acacia Catechu* growing in the moist climate of Eastern Bengal and Assam would be a paying concern. The proportion of catechin in the trees growing in Burma is generally much lower than in the trees of Northern India, and since crystalline catechin is easily decomposed by hot water, a large amount of catechin present in the wood is lost during the extraction of wood with boiling water and concentration of the extract. Further, during the long period of five days for which the concentrated extract is set aside to allow of the separation of catechin, a further loss in the quantity of catechin occurs. Dr. Warth is of opinion that catechin on long standing with water becomes converted into a soluble substance and thus it is lost; but I have found that cold water is without any decomposing action on pure catechin, but when the latter is mixed up with even a trace of catechu-tannin, it does undergo slow decomposition when allowed to stand long in contact with water. Whatever be the cause of decomposition of catechin in this case, it is certain that more or less of the catechin undergoes change during the five days' rest of the concentrated extract Under these circumstances it is not likely that the process of extracting catechin by means of hot water can be applied advantageously or even successfully to the manufacture of Katha from the trees in which the proportion of catechin is small. I think that unless hot water like iron, is regarded as a great enemy in the extraction of catechin and unless some other suitable solvent is substituted for hot water, the manufacture of Katha from the extract of the Burma or other trees in which the proportion of catechin is low cannot be made a paying concern.

I am of the opinion that the manufacture of Katha even from those trees that have a great percentage of catechin in their wood

can be made more paying if the wasteful method of extracting them with hot water is abandoned in favour of a better one, because the very extraction of wood with hot water entails a considerable loss in the quantity of catechin.

THE BEHAVIOUR OF METHYL ALCOHOL TOWARDS CATECHIN AND CATECHU-TANNIN

As a result of my investigation referred to in the beginning of this paper, I venture to suggest the use of methyl alcohol instead of water for the extraction of catechin. I have devised an exact method involving the use of methyl alcohol, carbon bisulphide and dry ether by which the whole amount of catechin can be successfully isolated from cutch and catechu wood, but that method is too scientific and costly to be applied to the commercial manufacture of catechin.

Katha, however, is not pure but only crude catechin, and it is possible by the use of methyl alcohol alone to separate Katha from the wood of *Acacia Catechu*. The process by which the separation is effected depends in principle on the following facts :—

1. Catechin dissolves readily, but catechu-tannin is sparingly soluble in cold methyl alcohol.
2. Boiling methyl alcohol easily dissolves both catechin and catechu-tannin
3. Both in the cold and at the boil, methyl alcohol has no decomposing action on catechin whether the latter is chemically pure or is mixed up with catechu-tannin.

It is found that when catechu wood in the form of thin shavings is extracted with methyl alcohol at the boil, the extract contains the whole amount of catechu-tannin and of undecomposed catechin present in the wood. Further, analysis shows that the methyl alcohol extract consists almost entirely of catechin and catechu-tannin with no or little proportion of other soluble matters of the wood, so that the use of methyl alcohol in the manufacture of cutch and Katha points not only to a considerable increase in the yield of Katha but to the production of a superior extract on account of the absence of much non-tanning matter in it,

The process of extraction and separation of Katha by means of methyl alcohol was first suggested in my Note on Cutch Analysis and then fully described in my " Note on Utilisation of Assam Khair Forests." The description of this process that follows is taken for the most part from these two notes.

THE NEW METHOD OF COMBINED MANUFACTURE OF CUTCH AND KATHA.

The wood in the form of thin shavings is macerated in cold crude wood spirit in ordinary closed wooden drums placed horizontally in a large room and fitted with brass lids screwed on to their tops and with stop cocks at the bottom, with occasional shaking for about 24 hours. The shavings are then taken out and fresh ones put in. This process is repeated till the spirit has extracted all the catechin from the quantity of shavings put in, whose percentage of catechin is known. Then the spirit is drawn out of the stop cocks and filtered through thick cloth into a still where it is distilled over at a gentle heat to recover most of the solvent for further use. It is recommended that before treatment with cold wood spirit the shavings should be put into small linen bags to facilitate the removal of the shavings from the drums and finally their being pressed under a hydraulic press to recover the spirit absorbed by them. The spirit thus recovered from the shavings is again put into these drums. The process of putting the thin shavings of wood in linen bags before maceration in alcohol would also render the process of filtration easier and more perfect by preventing to a considerable extent the mechanical suspension of the fine woody particles in the menstruum. After the spirit has been distilled off, the residue in the still is taken out if need be by the addition of a small quantity of cold water. This residue is crude catechin mixed with a small proportion of catechu-tannin. It can now be shaped into various commercial forms and dried.

The woody residue from the drums after having been pressed in an hydraulic press is afterwards extracted in copper cauldrons exactly on the same lines as followed by Burma cutch boilers for the manufacture of catechu-tannin or cutch to be sent as a dyestuff to the European markets.

Exactly the same method can be used in refining the watery extracts of *Acacia Catechu* for the isolation of Katha from them.

The loss in the quantity of wood spirit that occurs during the separation of Katha from the watery extracts or from the wood itself is estimated to be about 30 per cent.

It may be mentioned here that crude wood spirit is a cheap enough substance even now, but there are prospects of its becoming cheaper still when its manufacture is started on a large scale in India. So crude wood spirit, I believe, can be profitably used for the manufacture of Katha on a commercial scale.

THE COMBINED USE OF WATER AND WOOD SPIRIT IN THE CUTCH MANUFACTURE.

Though I think that the separation of crude catechin from the wood of *Acacia Catechu* should always be effected by means of crude wood spirit, to obtain the whole quantity of catechin present in the wood undecomposed, I don't think that it is always necessary to do so. Before deciding upon the method of extraction, as I have recommended elsewhere, a preliminary assay of the wood for catechin should be made according to my process described in my "Note on the Utilisation of Assam Khair Forests." If the wood is found to contain less than 3 per cent of catechin, the manufacture of Katha from it will not be remunerative, and consequently such wood should be utilised only for the manufacture of cutch for which purpose it is not necessary to extract it with wood spirit. It may be extracted with hot water and cutch manufactured from it according to the Pegu system of boiling cutch. The hot water extract of such wood will always be amongst the cutches of high quality readily saleable in the European markets and therefore need not be refined for further extraction from it of Katha.

The catechin in the wood of *Acacia Catechu*, growing in moist localities like that of the Goalpara Division in Eastern Bengal and Assam, has been found to be present in its amorphous condition and to undergo but little decomposition when such wood is extracted with boiling hot water, so that the extract from such wood may be safely

prepared by means of boiling water and afterwards refined for the extraction of Katha with cold wood spirit. The reason why refining too of this extract cannot be carried on by hot water again is that in the extract catechin is always found to exist as crystals the very form in which it occurs in the wood of *Acacia Catechu* growing in dry climate.

It may be remarked further that in the case of trees whether of Assam or elsewhere which are estimated to contain more than 3 per cent of catechin, if the extraction with wood spirit is regarded for one reason or the other as undesirable, even the hot water extract prepared according to Dr. Leather's recommendations is found to be sufficiently rich in catechin to make the separation of the latter remunerative. Thus if it is not desired to obtain the entire amount of undecomposed catechin from the wood in case it proves unmanageable to extract it direct with wood spirit, the watery extract of all such woods that have more than 3 per cent of catechin should be made first and then the extract so obtained be refined for the manufacture of Katha with cold wood spirit as described above.

The analysis of the wood of *Acacia Catechu* growing in the Siwalik Division showed about 9 per cent of catechin and 2 per cent of catechu tannin in the wood. This wood had also white spots in it. When seen under the microscope catechin from this wood unlike that from the Assam wood when seen in the methyl alcohol extract of the wood was crystalline and not amorphous. The cutch made by the hot water process from the Siwalik wood proved on analysis to be very much poorer in catechin than the cutches made from the wood of the Assam Khair containing 2 to 4 per cent of catechin only. Evidently the crystalline catechin is decomposed while the wood is boiled with hot water to a much greater extent than catechin in its amorphous state as occurring in the Assam wood.

Therefore I would like to divide the Khair wood to be operated upon for cutch or Katha into three classes —(1) the wood that has less than 3 per cent of catechin, (2) the wood that has more than 3 per cent of crystalline catechin, and (3) the wood that has

more than 3 per cent of catechin in an amorphous state. The last class should always be extracted first with hot water and only its watery extract properly dried should be used as the starting material for the manufacture of Katha by means of cold wood spirit. The class No. 1 should be used only for the manufacture of cutch and not Katha. As regards class No. 2 which contains more than 3 per cent of crystalline catechin, I recommend that it should be extracted first with cold wood spirit for Katha as given previously and then treated for the second time with boiling hot water to extract cutch.

CONCLUDING REMARKS.

As is well known there are three botanical varieties of *Acacia Catechu*—(1) *Acacia Catechu* proper, (2) *Acacia Catechuoides* and (3) *Acacia Sundra*.

Katha has hitherto been made only from the first variety, which is met with mostly in the forests of Simla, Kangra, Hazara, Kashmir, Oudh, Central India and Behar. Katha manufacture on a large scale has been found to be carried on only in the United Provinces and Central India, but there is no reason why the Katha industry should not flourish all over India especially in regions where *Acacia Catechu* grows in abundance. *Acacia Sundra* grows in the Bombay and the Madras Presidencies. Cutch only is manufactured from this variety. I have had no opportunity of examining cutch made from *Acacia Sundra*, but it is said to be inferior in quality to the Burma cutch. This, I think, is probably due to the fact that *Acacia Sundra* contains a larger proportion of catechin than the Burma variety. This opinion is supported by the fact that cutch manufactured in South Canara and some other parts of Southern India is like Katha mostly valued as masticatory and medicine. *Acacia Catechuoides* grows in Burma, Bengal and Assam. Cutch only has hitherto been made from this variety and cutch manufacture on a large scale has been a special industry in Burma. This variety can yield both Katha and good cutch as I have shown in my Note on the Assam Khair Forests.

It thus appears that Katha can be extracted from all the three varieties of *Acacia Catechu*, though the variety *Acacia Catechu* proper

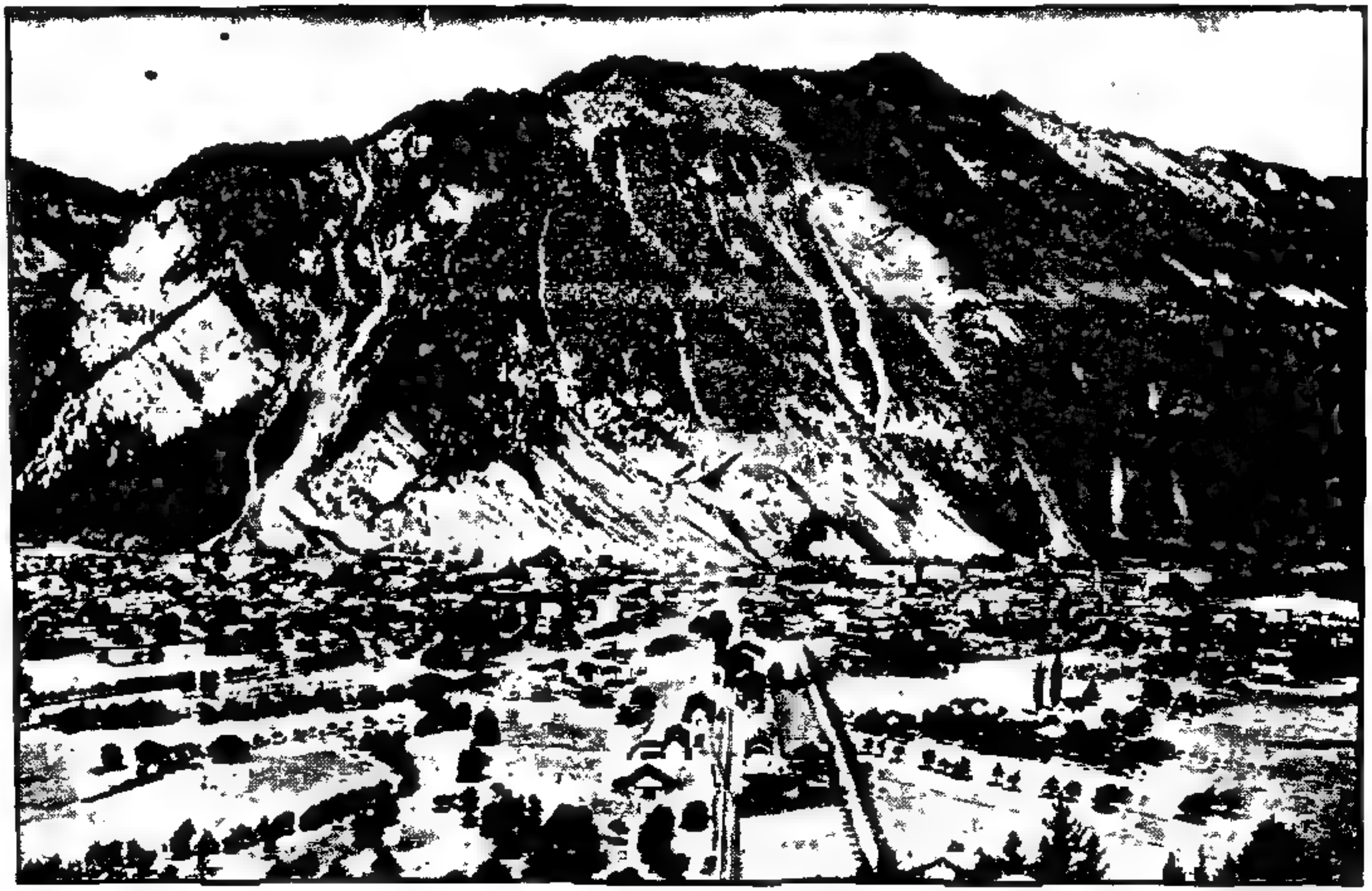


Photo.-Mech. Dept., Thomason College, Roorkee. Photo. by R. Gabler, Interlaken.

Southern aspect of Harder with Interlaken at foot in 1870.

would give the largest yield. Likewise it is evident that all the three varieties can yield catechu-tannin, the largest yield of the latter being from the variety *Acacia Catechuoides.*

It is not suggested that the manufacture of cutch and Katha should be started in all forests where *Acacia Catechu* is found. But if, as was once suggested by the Reporter on Economic Products to the Government of India, a map of India could be drawn up showing the distribution of *Acacia Catechu*, then tracts could be marked within this area of distribution, where factories could be established for the manufacture of cutch and Katha on a larger scale. In the rest of the area where mature cutch wood could not always be had, whenever the latter was available it could be chopped up or reduced to thin shavings and then transferred to the nearest factory.

It is a pity that the cutch and Katha manufacture has been allowed to remain in the hands of poor people, whom one cannot expect to be enterprising enough to expand or improve the industry to any considerable extent. Katha, as I have said, is a very valuable substance and it is greatly in the interest of the Forest Department to encourage its manufacture in all places where *Acacia Catechu* grows in abundance. Further on account of its being used as a masticatory and medicine, it is important that it should be manufactured by a neat and careful method. If prepared by the new method it could be exported to Europe where it is hoped it would readily regain its former position as a valuable astringent medicine which is now held by the gambier of Singapore.

I understand that it is proposed to start shortly the manufacture of wood spirit on a commercial scale in India. The distillation of wood spirit in India would have a direct and important bearing on the future expansion of Katha and cutch industries. For, as I have already said crude wood spirit is a cheap substance even now but its production in India would make it cheaper still. The extraction of Katha from the catechu wood or its watery extract could be made still more economical in a joint factory where the distillation of wood spirit could be carried on side by side with the manufacture of Katha and cutch.

In conclusion I may claim for the new process the advantage of its being very simple, requiring no great outlay in complex machinery, nor any special chemical skill to carry it on.

PURAN SINGH.

ORIGINAL ARTICLES.

SAND BINDING PLANTS.

There is nothing so significant as Nature and in investigating its phenomena, human ingenuity endeavours to bring under its control the so-called hostile forces of Nature and to use them for its own ends and purposes. Thus we see around us attempts made to turn to good account things which are apparently barren of any fruit; one such is the cultivation of some plant which can bind drifting sand, and thus protect useful lands from the encroachment of sand blown continually by sea winds.

A cursory survey of attempts made in different countries and different times will not fail to be of some interest to the student of the plant world in general and to the forester in particular.

Early in the eighteenth century the practical head of the American Republic realised the necessity of discovering some means of protecting the coast lands from the ravages committed by drifting sand. Many and varied were the experiments made with the result that in 1758 the then Government enacted certain specific laws to protect the sea shore of Long Island.

Three decades later, Mons. Bremontier carried out extensive experiments in the south-west of France. To him it became apparent that nothing good could come of these experiments until something were done to break the force of the prevailing winds. To this end, he directed all his efforts and the first step was to create a barrier to the drift—a wooden palisade of definite height, breadth and thickness erected at a short distance above high water mark. On the side of the palisade facing the land and therefore under its shelter were sown seeds of various kinds, specially *Pinus*

maritima, Arundinaria sp., Cakile maritima, Triticum sp., Artemisia sp., and *Salsola sp.* These sowings were continued inland along belts in succession until the whole area was covered with dense vegetation. The work of sowing and planting was carried on for nearly a century with the result that about 155,000 acres of sandy wastes have been transformed into the present thriving and prosperous pine forests, yielding timber and resin in abundance.

The stability of the great sea-dyke in Holland is due to certain creeping graminaceous plants and the Government of that country is keenly alive to the necessity of maintaining their growth there.

In many parts of Great Britain, the plants popularly known as Bentstar and Lymegrass (*Carex arenaria* and *Elymus arenarius*) play a very important part in the consolidation of sand on the sea shore and thus in the protection of the adjacent lands.

In 1893, Professor Wagner recommended *Lathyrus sylvestris* to the Prussian Minister of Agriculture for planting along the coast of North Germany.

Again in Australia this class of plant is being largely utilised for the same purpose, and Mr. Bundley of East Wellington has achieved considerable success by sowing lupines.

Turning to inland tracts, by far the most interesting record is that of the Trans-Caspian desert. It was here that General Amenkoff and other projectors of the Railway scheme tried various experiments with indifferent success until at last *Haloxylon Amodendron* was discovered and the encroachment of drifting sand was effectively checked. Another plant of the same order (*Chenopodiaceæ*) is found in the district of Coimbatore (Sir J. D. Hooker). This is closely allied to another sand-binding plant *Suæda nudiflora* found along the Coromandel Coast in localities characterised by an abundance of salt.

In India, we find very interesting records of similar attempts. The rapidity with which sand was drifting towards the city of Madras from the sea shore, east of the Fort and old Light-house necessitated the adoption of effective measures to arrest the drifting sand so early as 1849, and Colonel Worster was the first to suggest the planting of indigenous sand-binding plants along the

coast. Calcutta, Kutch and Madras on the sea coast and Jaipur and Hoshiarpur further inland afford us evidences of similar attempts being made and crowned with success. In 1882 Surgeon-General Balfour suggested to the then Viceroy the necessity of protecting land from the encroachment of sand blowing from the sea, and Madras Presidency is somewhat fortunate in the fact that such a necessity was recognised even in the days of Koenig and Roxburgh. It was in the year 1855 that Doctor Cleghorn, the then Conservator of Forests, Madras, was requested by the military authorities to suggest some means of binding sand near Sir A. Cotton's "groins." Experiments tried on the coasts of Tanjore and Tinnevelly were successful and they confirm the suggestions of Doctor Cleghorn. Later on in the year 1882-83, Dr. G Bidie and Mr. J Stevenson were engaged in finding out indigenous plants best suited for binding sand. More recently, in the year 1891, the drifting sands of the Vamsadhara near Maripam, Ganjam district, were fixed by planting *Casuarina*.

The terms *sand-binding* and *sand-loving* are used indiscriminately with reference to plants growing wild in sandy regions; hence the mistaking of all plants growing in sands for sand binders. As a matter of fact, the former term includes but a few plants, while the latter is a misnomer They by no means love the place where they are found and very probably thrive as well, if not better, in other localities.

In the lists given by Messrs. Stevenson and Clarke (Watts Dictionary) not all but only a few are typical sand-binders.

A sand-binder is a plant which consolidates the loose shifting sands thrown up by wind or waves by means of its structures modified considerably by the surrounding environment. This can be well illustrated by describing an ideal plant, *Koenig maritima*. It is a creeping perennial with main stem and root of considerable thickness running deep down into the soil with many hundred branches ramifying in the soil and sub soil for a considerable distance in quest of food and water, terminating in minute branchlets and rootlets, the former coming to the surface and producing a number of thick, succulent spreading leaves, the latter branch

out into a number of still more minute rootlets, provided with absorptive root-hairs and arising at definite places for anchoring purposes. Thus, it gives rise below to a sort of interwoven network of underground stems and roots and above to a sort of carpet of short-petioled green leaves, the whole occupying a dune high above the ground.

A ramble along the Coromandel Coast from Ennore to Sholunganellore, a distance of 25 miles, and an occasional visit to Fort St. David in the months of April and May are enough to impress one with the importance and efficiency of sand binders. The narrow strip of sea beach is nowhere perfectly flat but broken by dunes, the tops of which are five to ten feet higher than the bases. The prevailing wind is south-east by south and the dunes are arranged in parallel lines and at right angles to the direction of the above wind the sides of the dunes falling away precipitously. This is the condition of the narrow strip of the sea beach on which the naturally-drifted sand heaps are arranged in parallel ridges. Behind this narrow strip of sandy area is seen a belt of low ground with stagnant water, and behind this again a cluster of villages with cocoanuts and palms.

Hot air more or less saturated with salt spray alters the consistency of leaves rendering the plants growing in the sand peculiar in appearance. For one thing the leaves become remarkably succulent. For example, the plant *Sueda nudiflora* growing on the sea beach is stunted and has thick and cylindrical leaves of varied hue, while the same plant growing farther inland, *i.e.*, far away from the influence of salt spray is devoid of brilliant hue and succulency of leaves and grows to a height of four feet. This peculiarity, namely, stunted growth with succulent leaves, which will be considered later on in detail is one that distinguishes maritime plants from those that grow inland.

Temperature too plays an important part in modifying the growth of maritime plants. The temperature of the sandy beach of and about Madras is 86 degrees F. on the average. The intense heat coupled with the paucity of water, characteristic of these regions, renders the locality unsuitable for the successful growth of

plants. A long dry summer combined with heavy gusts of wind brings about certain characteristic changes in plant-structure. Excess of radiation and the absence of vegetation in the broad expanse of the shore accounts for the extreme warmth of the region. As indicated above, the plants that flourish here and are destined to play not an inconsiderable part in the consolidation of the soil are so modified and adapted to this peculiar environment as to thrive well even in such an unsuitable locality.

The soil underneath the dunes is more compact, and it is to this source that most plants have to look for their sustenance and stability, though a few seem to prefer the loose surface soil. The sub-soil is saturated with water, holding in solution salts and decaying organic matter. In considering the chemical and physical properties of soil and sub-soil in these localities, it must be borne in mind that the beach was once the bed of the ocean, and that organic remains in various stages of disintegration and decay must be in existence; that water percolating through soil and sub-soil contains particles of alkaline salts and other nutrient substances in solution, derived from both sea and land.

But the two characteristic features of soil composition of these sandy tracts, which are undoubtedly of most importance, deserve to be briefly noted here. One is the paucity of water which exercises a decided selective influence on certain plants. The second is the excess of mineral salts derived from the sea in spray or by percolation which renders absorption of water and food-material by osmosis very difficult for most plants. *It is clear that the above two conditions of soil composition will not suit every plant, and that* only plants which can be satisfied with the limited supply of water in the soil and which can counteract the injurious influence of concentrated salt solutions and manage to draw in the necessary food-materials from the above source are likely to survive in the struggle and establish themselves. On the other hand, vigorous vegetative growth where organic matter is superabundant and probably *due to the fact that organic substances are able to absorb* and hold tenaciously many concentrated solutions, letting those again gradually wash out under the influence of rain or fresh water

in a dilute form in which they are not injurious to plants. In this way, the injurious action of concentrated salt solutions are counteracted and plants like *Mollugo spergula* put forth abnormal leafy shoots with few or no flowers.

Light affects the plant through their leaves which are highly sensitive to the rays of the sun. It is the chlorophyll corpuscles through which the propelling force of the fountain of all organic life works and gives rise to organic materials essential for plant life. Without sunlight there can be no green chlorophyll, and consequently no formation of organic compounds. Thus the light of the sun is as essential to plant life as water, carbon dioxide and other food-stuffs. This demand of light is met by cells which contain chlorophyll corpuscles and it is a demonstrated truth of vegetable physiology that the colour of foliage leaves is determined by the intensity of light, *i.e.*, intense sunlight gives a lighter green, while weak sunlight gives a darker green to the leaves. This change in the colour of leaves has been known to be brought about by the displacements of chlorophyll corpuscles, for in diffused sunlight they arrange themselves on the short walls of cylindrical palisade parenchyma parallel to the surface, rendering the leaves dark green, if looked at in the direction of incident light, and in direct sunlight, they arrange themselves on the long walls parallel to the incident rays, thus making the leaves look paler than before. We see thus the living protoplasm has the power of adjusting the arrangement of these chlorophyll bodies by placing them in positions best suited to the illumination

How is it then that sand-binding plants flourish in places exposed to glaring sunlight? The adaptive structures developed for the purpose of checking over transpiration also play the part of light regulators. For example, plants growing in shady groves of *Casuarina* have neither hairs nor thick cuticle in their broad leaves but look darker than those growing in direct sunshine.

In the *Casuarina* plantations at Kanjambakam, *Ipomœa biloba* plants are seen growing in great numbers and in excellent conditions with leaves broad and thin and of a dark green hue. Compare these with those growing under the influence of direct

sunshine. In the latter case, the leaves are thicker and narrower but of a lighter green colour. The explanation of these differences is to be found in the fact that *Ipomœa* of the *Casuarina* plantations grows in the shade and utilises all the available sunlight, while those growing in the glaring sunshine have leaves of a dull light green colour with a thick cuticle protecting the tissues below from the intensity of illumination. Again, an examination of the nature of plants growing in the moat round Fort St. George convinces one of the truth indicated above. The plants that grow in the shade of parapet walls have the benefit of diffused sunlight and also freedom from the salt-saturated atmosphere of the sandy beach. Hence the dark green tint, the broad surface and thin consistency of leaves, whereas the same plant growing on the other side of the moat has to protect itself from too much sunlight. Hence the dull green colour, the shrivelled surface and thick consistency of leaves. In this connection, it may be noted that certain small plants growing in the crevices of parapet walls, where only a few and scattered rays illuminate the otherwise dark and concealed corners appear bright and beautiful emerald green. The probable explanation of this phenomena is that the few rays that get into the crevices are so concentrated and reflected back as to give them an abundance of light.

The influence of wind is not the least noticeable in the growth and attitude of plants, as stunted growth is partly to be attributed to the blowing of dry wind, while prostrate attitude is entirely due to the action of high winds. For example, plants that grow in the *Casuarina* plantations, particularly in low and depressed situations (in ditches) where the force of the wind is considerably counteracted, are more or less erect with leaves having a petiole as much as 8 inches long. Again the plant *Herpestis monniera* grows on the sea coast prostrate and rooting at its nodes resembling other maritime plants, while the very same plant grows near Kilpauk (quite inland) erect with no adventitious roots.

The average annual rainfall on the Coromandel Coast is about 35 inches and is confined to three months in the year. Consequently, the influence exercised by the above factor on the growth

of sand-binding plant is little or nothing, for they thrive uniformly well all the year round.

Lastly to the sea and its waves are due the silting up of organic remains, the presence of salts in the soil, and the appearance of certain maritime plants not indigenous to the soil. These exotic plants have found their way into the Coromandel Coast through the agency of waves and other similar means. Some of them remain on the coast while others extend inland. For example, those plants which have heavy seeds are littoral, while those which have light seeds and other buoyant structures spread inland far and wide. To begin with, the cocoanut palm is a native of Cocoa Island, Laccadives and Nicobar Islands. M. Condolle discusses briefly the arguments in favour of an American as well as those of an Asiatic origin for this tree and concludes by expressing the opinion that it most probably belongs to the Indian Archipelago. "Its introduction into Ceylon, India and China does not date further back than 3,000 years, but the transport by sea to the coasts of America and Africa dates further back." From its long duration in this land, it is considered indigenous, but it is certainly due to the action of waves that the light and buoyant seed of *Cocos nucifera* should have reached our shores.

Next, we have the composite plant *Tridax procumbens*, almost ubiquitous. This is a South American species that must have come to us through the medium of goods brought by merchants (Americans or Spaniards). This has extended right into the interior of this land, nay, on the very heights of the outer Himalayas. Although it was probably unable to cross big rivers, the vast and extensive railway communications have carried it to all places within its reach. The rapidity with which it distributes itself is due to the papus (seed) blown about by wind.

Again, *Flaveria australasica* is another foreigner. Very likely this Australian plant must have reached our shores with the horses imported by traders from Australia. This is usually seen on the coasts and rarely inland. (Mr. J. F. Duthie informs me that he has specimens of this plant gathered on the banks of the Godavari river, in the Chanda District, Central Provinces.)

Again, *Scaperia dulcis*, another American plant, has reached India in spite of its heavy seed and has gone up to Siliguri and Srinagar crossing the Ganges on its way.

Lastly, one species of *Barringtonia*, regarding the habitat of which there seems to be some doubt, was found near Sholinganellur. It must have come either from Travancore or from Ceylon.

The prevalence and abundance of these foreigners on the coast have mislead some authorities in calling them sand-binders.

Peculiarities due to the action of the agencies indicated above on the sand-binding and other maritime plants next claim our attention.

Root system.—The roots to begin with are characterised by their enormous length. Generally the tap root is thick and sturdy, penetrating deep down into the earth and full of water, thus rendering it extremely brittle. For example, *Launæa pinnatifida* has its tap root three feet in length, while *Spinifex* and *Ipomœa* have still longer roots. However, it is the lateral roots that are wide spreading and form an underground network. The lateral root of *Ipomœa biloba* has been found to be as much as twelve feet and that of *Spinifex* twenty feet. On the coast of Fort St. David, a huge dune is bound up by a regular network of root and rootlets, one tiny rootlet measuring by itself five feet with its root-hairs sticking on to particles of sand.

The root tip is very highly sensitive and always turns in the direction of moisture and food, even against the force of gravity. The root-hairs penetrate the loose surface soil and throw aside particles very easily. These have great adhesion to the particles of sand.

The presence of adventitious roots is another feature peculiar to these sand-binding plants. They appear almost anywhere on the plants, *i.e.*, in any part of the stem, at the nodes or even on the internodes, at the base of petioles or even at the base of leaves. Generally, these appear at the nodes for the purpose of anchoring the plant to the soil, and it is to the presence of these structures that the effective binding of the soil is due. Thus the wind blowing

against these plants can neither disturb them nor loosen the soil bound up by their roots.

Underground stems of sand-binding plants are typically provided with thin but wiry adventitious roots. In rare cases however, as in *Launæa pinnatifida*, these extend right down into the earth, become thick and serve as tap roots. Meanwhile, the stolon connecting this new rosette of leaves and the mother plant dries up and disappears

Stem.—The main stem is short and thick, found deep down in the earth. It is mainly the branches that creep underground to great lengths and thus bind the soil. The terminal portions of these underground branches, however, come up to the surface and put forth green fresh shoots The family of *Gramineæ* and *Cyperaceæ* have a good number of typical sand-binders, extending their underground creeping stems and branches to enormous lengths. For example, *Cyperus arenarius* sends out branches to a length of fifty to sixty feet with innumerable side branches and branchlets. One underground stem of *Ipomœa biloba* measured 42 feet while a branch of *Canavalia obtusifolia* measured 35 feet. *Hydrophylax maritima* has its thick underground stems running to 15 feet in length. *Launæa pinnatifida* has its green stolon up to 10 feet in length.

The depth to which these underground stems reach varies from 6 to 12 inches

All these plants are characterised by their long internodes. For example, the average length of the internodes of *Ipomœa biloba* is 6 inches, while the same plant growing further inland has only 3 inches of internodes on the average.

Each main stem gives off a number of side branches, while from each of these latter a number of secondary side branches arises, which in their turn branch and re-branch till ultimately each one terminates in fresh shoots or buds. Add to this the presence of adventitious roots all over the area in question. These underground stems strongly secured to the ground by means of adventitious roots cross one another, ramify through and through and thus bind the whole ground in a kind of network.

Leaves.—One feature noticeable in the leaves of sand-binding plants is their small size, which lessens the transpiring surface. In certain other plants, leaves assume cylindrical shapes which has the same effect, namely, the reduction of transpiring surface. The small size is mainly due to the prevalence of drought on the sea shore.

The second feature is the considerable degree of succulency possessed by most plants growing on the sea beach. This remarkable fleshiness is due partly to the presence of salts which the plants obtain from the soil, partly to the moist atmosphere, and partly to the presence of water storing tissue.

The succulency of minute twigs of *Casuarina*, for example, is mainly due to salt spray of the sea coast. Thus the side turned towards the sea is only influenced in the above way, for such succulent twigs can only be seen there and at places within the reach of the spray.

The development of water-storing tissue which gives rise to succulency in those plants (ships of the desert) necessitates the presence of a thick cutic . Cuticularisation of the epidermis helps the underlying tissues from giving off water contained in them. It is often noted that cuticle gets thicker under direct sunlight than under shade. What is cuticle? It is merely cellulose modified and replaced by a mixture of stearin and the glyceride of a fatty acid (suberic acid) forming cutin or suberin. These layers of suberin filled with air act as bad conductors between the external atmosphere and the internal structures. Thus the effect of a thick cuticle is first to prevent over-transpiration and secondly to ward off excessive light.

In the absence of such thickened epidermis, Nature provides the leaves with a coating of some excretions (salts, wax, resin, mucilage, etc.) Salts, dissolved in water as sodium chloride and magnesium chloride, obstinately retain water in large quantities and this resistence of salt is far more effective than mucilaginous or even resinous secretions. For example, the Chenopodiaceous plants, particularly *Sueaa nudiflora*, are characterised by their cylindrical and succulent leaves and by the presence of salts of

soda which check the rapid evaporation of water. It is one of the most surprising of Nature's phenomena to see these plants rising above the salt soil of Adyar, succulent and green in the month of May when the vegetation all round is parched up by the intense heat of the sun, when the days are not tempered even by passing clouds and when the prospect of rain is remote. In this connection, it may be noted that excretions of salt and lime are met with only in maritime plants and on those whose foliage rests on the soil; for it is out of question with trees like *Casuarina* to support the weight of these incrustations. These secretions arrest over-transpiration and keep off the intense glare.

Next we have hairs or trichomes. The function of these structures is the same as that of the secretions noted above.

Stomata are comparatively few in number and are confined to pit-like depressions.

Thickness of leaves is invariably accompanied by great development of palisade tissue either in volume of all the cells or in the greater number of layers. This abnormal development of the palisade tissue necessarily encroaches on the lacunæ and intercellular spaces which are consequently reduced.

Lastly, chlorophyll is generally less abundant in these maritime plants by a reduction either in volume or in the number of grains which accounts for the rarity and scarcity of starch granules in the leaves

Thus the leaf which is the centre of assimilation and transpiration is modified to suit the surrounding environment. All the peculiarities noted above in the structure of the leaf produce the desired effect of arresting excess of transpiration and shutting off the intense glare of the sun.

To sum up, under the influence of definite strength of sunlight and through the activity of chlorophyll corpuscles, organic compounds are manufactured in the leaves. Nutrient food salts dissolved in water have to reach the leaves for purposes of utilisation. To bring about this transference of food-material two forces play a prominent part, one being root pressure and the other transpiration. The former is due to the absorptive activity of

root-hairs and processes of osmosis, while the latter is due to evaporation in the surface cells of the leaves. Intense heat combined with great drought bring about rapid evaporation which necessitates an over transpiration. To counteract this excessive transpiration, a considerable quantity of water has to be provided by the roots. But the supply of water in the soil is limited. Consequently over-transpiration ought to be checked Again, chlorophyll corpuscles in the leaves are effected by too much sunlight and therefore excess of sunshine ought to be avoided To affect this satisfactorily, Nature has provided maritime plants with the following adaptations in their structure : —

1. Reduction of transpiring surface as brought about by the small size and cylindrical shape of leaves,
2. Succulency
3. Cuticularisation
4. Secretion of salts, resin, etc.
5. Trichomes or hairs.
6. Glaucous blooms
7. Formation of wrinkles, folds, pits, and groves.

As the number of leaves is limited and as the sunshine is intense, there is hardly any necessity for the leaves to have petioles of varying lengths ; hence the uniformly short petioles as compared with long and short ones seen in plants growing under shade.

The sensitiveness of plants growing about sandy regions is not yet definitely known, as my experiments on sensitive plants (*Mimosa pudica*) grown in pots near the sea were not successful for one reason or another. But I am inclined to believe that intense heat, dry wind, and presence of salt in the atmosphere are unfavourable to sensitiveness, which implies thinness of structures.

Colour of the leaves (glaucous hue) of sand binding plants under the influence of light and shade has already been dealt with

Flowers.—In the sand-binding plants, flowers are not scarce as they blossom almost throughout the year.

Generally fertilisation and dispersal of seeds are effected by the agency of wind and in some rare cases by insects as well.

In a few plants, flowers are being replaced by hooks or hook-like trichomes.

Growth.—The growth of these sand-binding plants is generally stunted. This is due to the abundance of salt in the sub-structure of leaves which reduces the assimilation of carbon.

I have thus shown how the creeping underground stems, branches, roots and rootlets with their spreading leaves act as efficient agents in binding loose sand.

Certain maritime plants flourish in other regions under other environments. The extremes of heat and cold bring about similar changes in the structure of plants. In other words, too much of heat or too much of cold acts as a check to the normal development of cellular tissue which is compensated for by the growth of abnormal epidermal structures. For example, some plants which adorn the high peaks of mountain ranges are also found in low sun-burnt tracts. The structures developed to check over transpiration in maritime plants are useful to ward off the excessive cold in mountain regions.

Apart of extreme environments which bring about similar modifications, we have instances of plants flourishing in neighbouring regions with this difference that the peculiarities of sand binding plants are absent. In some rare cases, however, they retain their hereditary characters. For example, *Herpestis monniera* creeping along the beach with its number of adventitious roots assumes exactly the self same attitude on the banks of the back water near Kilpauk (six miles inland). Again *Ipomœa biloba* shows the same tendency for the creeping style of growth, however it grows with this exception that thickness and narrowness of leaves are wanting in plants growing inland far away from the shore. But *Lippia nudiflora* grows all over the meadows and waste grounds, creeping and rooting at nodes, only devoid of succulency peculiar to sandy tracts. So also is the *Spinifex squarrosus* which retains the hereditary structures whether found in sandy beach or near cultivated fields.

Lastly, similar conditions of environments bring about the same result. Thus *Spinifex squarrosus* of the Madras coast may be said to represent *Haloxylon amodendron* of the Trans-Caspian

region, *Casuarina* of Australia, *Tamarix* of Africa, *Thujas* of Japan and *Veronica* of New Zealand.

True sand-binding plants are represented by a few natural orders on the littoral coast of Madras The most important order is *Gramineæ*. A number of grasses act as splendid sand binders.

LIST OF TYPICAL SAND BINDING PLANTS

I. Spinifex squarrosus, Linn. (ground rattan).—This is popularly known as Ravana's whiskers, from the appearance of the congested male spikes carried by the wind to the female flowers

II. Cyperus arenarius, Retz.

III. Ipomœa biloba, Forsk. (Rabbit weed).

Lisboa alludes to a reputed practice of twining the creeper around the cot of a Hindu mother, apparently from the idea that as it binds the sand on the sea shore, so it will secure the child to the mother against the goddess of destiny.

IV. Canavalia obtusifolia, D. C.

V. Hydrophylax maritima, L. f.

VI. Spermacoce hispida, L. f.

VII. Launæa pinnatifida, Cass.

VIII. Pupalia orbiculata, Wight

IX. Pandanus odoratissimus, L. f. (screw pine).

It is the tender white leaves of the male flowers that yield that most delicate fragrance for which they are universally and most deservedly esteemed.

X. Casuarina equisetifolia, Forst

Chittagong, southward to Malay Islands and Australia.

This is by no means an exhaustive list of sand-binders but merely represents those that were actually seen and whose effects were actually experienced. The last mentioned of these thrive exceedingly well on the sea coast, growing down to the high water mark and even in loose sand. When they are left unpruned, they send out decumbent horizontal branches which give rise to adventitious roots. In places where they grow wild, they form a most singular thicket, both above ground and under ground, and

Photo-Mechl. Dept., Thomason College, Roorkee. Photo. by R. Gabler, Interlaken.

Southern slope of Harder with Interlaken in 1908 showing re clothing with forest.

by means of their innumerable roots and decumbent stems bind a loose sand most effectively. Two facts with regard to their internal structure deserve to be noted here:—

(*i*) Practically leafless. Young shoots perform the functions of leaves. The stems of these green shoots have deep longitudinal grooves on the surface, at the bottom of which stomata are found.

(*ii*) Particular tissues within are used for storage of water.

V. SUBRAMANIA IYER.

OBSERVATIONS ON THE REPRODUCTION OF TERMINALIA CHEBULA IN THE MAHABLESHWAR RANGE.

For many years past hirda (*T. chebula*) has been regularly sown by guards in mounds, trenches and patches; but the success obtained has been insignificant. Such unsatisfactory results may be due to one or more of the following reasons :—

Firstly, unripe fruit may have been collected and sown. Guards in their eagerness to complete as soon as possible their annual collections of seed are apt to gather unripe myrobalans without noticing whether the fruit is mature or not. The fruit should be collected off the ground and not off the tree, otherwise it is obvious that the course of Nature is not being followed, and so the achievement of good results is an impossibility.

Secondly, if ripe fruit has been collected the collection may have been placed in a store-room and never put out in the open until sowing time. We know that the essentials to germination are a certain amount of warmth, moisture and air; also, that each of these essentials varies in the seeds of different species. It appears, therefore, to be necessary that the fruit should be spread out in the shade of tree, preferably hirda, and thus be subjected to successive heating and cooling influences which subsequently cause the shrunken mesocarp and epicarp to relax their hold on the endocarp which is then able to easily split open and free the seed. It has been said above that the fruit should be placed in the shade, that is, as Nature places it. If it is put out so as to receive the

full strength of the sun's rays then the degree of shrinkage in the mesocarp will be greater. It will be shown further on how the degree of shrinkage affects germination.

Thirdly, the sowing area may have been unsuitable for germination. Under natural conditions the fruit falling from the tree is afforded some overhead shelter and remains in a thin layer of leaves and other débris. In plantations the myrobalans have been placed on clean mounds and patches devoid of humus and situated in blanks; they have, therefore, experienced different degrees of temperature to what they would have if they had been naturally sown. By sowing under the borders (most of the fruit is borne on the edges of crowns and drops more or less perpendicularly to the ground) of the crowns of trees, by mixing a suitable proportion of humus with the soil, and covering each mound and batch with a thin layer of similar débris we would show our ready acceptance of Nature's hint. It may be contended that a clean, loose, moist, warm bed is all that is necessary for germination—(*vide* "A Concise Manual of Sylviculture," page 198). This may hold good for field crops and many forest species, but it cannot be proved that such a germinating bed is suitable for *all* forest species, since profuse natural regeneration of certain species, such as *Memecylon edule*, *Actinodaphne Hookeri*, etc., may be observed in places with undisturbed soil, undecomposed humus and much decaying débris.

Fourthly, most of the fruit when sown may have been destroyed by its enemies. It is a fact that the common striped squirrel (*Sciurus palmarum*) does immense harm to the seed in plantations. In Dr. Schlich's "Manual of Forestry," Volume IV, page 103, we read that "the harm done by squirrels is greater than is generally imagined." The collection of myrobalans for commercial purposes is carried on so keenly by the contractor's agents that squirrels are deprived of a great portion of this particular food Nature intended for them. Fruit sown on clean mounds and patches is a conspicuous object; hungry squirrels soon spy and devour it. Rats commit similar damage. In the course of Nature fruit falls amongst decaying leaves that help to conceal it from its natural enemies. Moreover, provision is made for the wants of animals and a balance

remains for the perpetuation of the species. Therefore, in plantations every effort should be made to conceal the fruit by a light layer of débris.

Fifthly, if germination took place the requirements of the seedling may not have been satisfied. Germination usually occurs at the beginning of the monsoon. A well-drained surface soil is absolutely necessary for the plantlet's welfare; if it happens to be in a depression the accumulation of water kills it. Trenches are therefore, quite unsuitable. The surfaces of mounds and patches should be always such as to ensure thorough surface drainage. Wild pigs and sometimes cattle walking over a plantation make holes in seed beds thus giving them very uneven surfaces which are consequently ill-drained. Though the seedling is able to survive light, to moderately heavy, continuous showers, it quickly succumbs to a heavy downpour lasting five or six days. Violent rain causes the cotyledons to drop off prematurely and the death of the plantlet follows. This occurs in mounds and patches. Under natural conditions the cotyledons are not only sheltered by the parent tree but enjoy the advantage of being protected to a certain extent by débris. Hence sowing should not be done in the middle of a blank but rather on the edge of it.

In a previous "Note on *Terminalia chebula* and its fruit the myrobalan of commerce" contributed by the writer to the pages of the *Indian Forester*, the process of collecting and drying the fruit for commercial purposes was described in detail. Commercially, the ridged fruit is considered more valuable than the unridged, it will be shown later that sylviculturally the reverse is the case.

It has been noticed that the unridged myrobalans give a better percentage of germination than the ridged. The question naturally arising from the use of these two terms is why should some be ridged and others not so. Such a difference may in some cases be due to the entrance of a fungus which converts the fleshy mesocarp into a coarse, black powder which does not shrink; the epicarp, therefore, remains unchanged in shape, that is unridged. This fungus is usually preceded by an insect which bores a hole about the shape and size of a pin's head through the epicarp but does

not go beyond the endocarp. Again, the mesocarp of one fruit may contain much less shrinkable matter than that of another; it follows that this will make a difference in the amount of shrinkage in each individual fruit, and, therefore, in the degree of ridging. Further, it is quite possible for some myrobalans to hold scarcely any shrinkable matter in the mesocarp, in such cases the dried fruit will remain practically unridged. Now the more the mesocarp and epicarp shrink the more compactly will they enclose the endocarp, that is to say, it will be less difficult for the putamen of an unridged fruit to split open and free the seed than for that of a ridged one to do so; because in the latter case the mesocarp, being made harder and more compact by shrinkage, is less affected by the influences necessary for germination; the pericarp, therefore, does not swell, rot and liberate the seed so easily as in the former. It has now been shown—

(i) why some myrobalans are unridged;

(ii) why others are slightly ridged and some deeply ridged; also,

(iii) why unridged ones germinate more freely than the ridged variety.

The following practical illustrations sufficiently substantiate the last statement. If at the time of sowing, a large number of perfectly ripe, ridged myrobalans be broken up it will be found that in each case the seed is perfectly healthy. Again, if ridged fruit, in which no germination has occurred during the rains, be carefully opened it will be observed in almost every instance that the embryo has either died or is decaying; such failures are obviously due to the hardened state of the parts enclosing the seed. It must, however, be added that in exceptional cases germination takes place during the second year after sowing. We know that no species will germinate out of its appointed season. Such exceptions may thus reasonably be accounted for by moisture reaching the seed late, namely, when the period of germination for this particular species has expired, a time of dormancy then follows during which the seed, being well protected, remains healthy; such seeds are the first to germinate the following year.

When germination occurs the endocarp gradually splits longitudinally, the radicle passing outwards in the direction of the scar caused by the severance of the fruit-stipe, that is to say, along the line of least resistance. The new-born plantlet casts off the pericarp at the end of the first week of its existence. Thereafter it exhibits cordate cotyledons with slight emarginate tips; these cotyledons sometimes persist for over three months and are much larger than the secondary leaves. During this early stage the seedling devotes most energy to the development of the root-system, the tap root descending to a good depth; above ground little growth is noticeable. This habit of the species is in marked contrast to that of its chief associate *Eugenia jambolana*. *T. chebula* having developed itself advantageously is consequently better able to obtain its requirements from a summer soil; at this season a great number of *Eugenia* seedlings die owing to the drying and shrinking of the surface soil from which the plantlets with insufficiently developed root-systems are unable to obtain enough nourishment; this is particularly noticeable in plantations with recently disturbed soil which naturally would dry and shrink to a greater extent and more rapidly than undisturbed soil. The damage done by the sudden shrinkage of loose soil resembles that known as the "uprooting of seedlings by frost", the effect is the same but the causes are different, *i.e.*, drought and frost.

Natural reproduction of *T. chebula* is adequate in some places but in others it is either very scarce or wholly wanting. By observing the usual position of self-sown seedlings it is concluded that some lateral shade is necessary, though a few young plants may now and then be noticed in blanks; such are, however, invariably backward in growth; they are nursed for a part of the year by broad-leaved monocotyledons such as *Circuma caulina*, etc., and at another time by species of *Filices*, for example, *Pteris sp.* Seedlings may be seen on the banks of streams but never in the actual water-courses.

The species is fire hardy. No sooner is it killed down by fire than it vigorously recovers itself and sends up new shoots. Repeated fires cause the lower part of the stem to become knotty

and to resemble the damage known as "frost canker" It may be true that a light ground fire sweeping over an area and charring only the mesocarp would facilitate the splitting of the endocarp, and so aid germination But taking the forest as a whole, it is considered that the harm done by such a fire would far outweigh the good, because it would seriously interrupt even to a critical degree the progress of all young growth and would destroy the seeds of other species which always outnumber *T. chebula*. It is believed that a mixture of species is an association, the object of whose existence is the rendering of reciprocal aid among its members by bringing about suitable changes in the soil, at all times, therefore, any experiment, in which fire is to be employed in connection with a single species, must be decidedly dangerous in a forest containing a variety of species.

The subject of hirda reproduction deserves serious and urgent consideration in view of the following facts:—

(*a*) villagers illicitly fell trees of *T. chebula*, the wood of which being hard and durable they utilise it for agricultural implements and building purposes;

(*b*) the present scarcity of self sown seedlings in many areas;

(*c*) the repeated failures in plantations;

(*d*) the deaths of trees from such causes as old age, suppression, fires followed by disease and damage by wind; and

(*e*) the annual sale of myrobalans by the department regardless of any reservation for purposes of natural regeneration.

Trees felled illicitly are usually cut two or three feet above the ground surface; on detection such stumps should be coppiced by guards. *T. chebula* being a strong coppicer we would, in time, obtain a number of independent trees instead of short-lived pollard shoots dependent for their nutriment on a decaying stump. Offenders when detected should be severely punished.

Natural reproduction will not improve until remedial steps are introduced. A simple measure that will ensure the perpetuation

of the species is the division of a Range into a number of blocks, these in turn being sub-divided into compartments. Sub-divisions should consecutively be closed against cattle for five years and the collection of myrobalans therein strictly forbidden during that period. The ever-present grazing problem appears to be the only difficulty.

There is, however, no reason why grazing facilities should be interfered with to a harmful extent so long as the blocks are worked at the same time and care exercised that the compartments closed simultaneously are small and widely scattered. Such an arrangement may appropriately be termed a "Plan for the Natural Reproduction of Hirda.

Our past methods indicate wide deviations from the path of Nature and meagre knowledge regarding the conditions necessary for the successful artificial reproduction of hirda. That no harm is done by continuing the experiment is readily admitted, but alterations in methods appear to be imperative. In the meantime it is of paramount importance that ample provision should be made for the natural regeneration of the species—hitherto an utterly ignored measure. In other words, conservation should be the primary consideration and exploitation the secondary.

If some conservant steps are not introduced; then time alone will reveal to the forester that he is answerable for the disappearance of what is now a valuable and constant source of revenue.

J. E. C. TURNER.

REVIEWS AND TRANSLATIONS.

HAND-BOOK OF TREES OF THE NORTHERN STATES AND CANADA EAST OF THE ROCKY MOUNTAINS.*

PHOTO-DESCRIPTIVE

This handsome volume is by Romeyn B. Hough, B.A., the author of the well-known series of volumes on "American Woods." The book is designed to meet the wants of the amateur observer of trees, the lumberman and the technical botanist. The camera has been called into requisition to portray accurately all the details of each species, the illustrations representing nearly seven hundred negatives. The arrangement of the book is delightful. A pair of pages facing each other are devoted to each species. On the left hand page the leaves, fruits and leafless twigs in winter are depicted. The photographs, having been taken against a sectional back-ground with one inch squares, make the actual size of each part clearly apparent and render easy the comparison of the dimensions of different species. This arrangement is a most advantageous one and we strongly recommend it to any one who takes up the photographs of botanical specimens, for the degree of magnification or reduction can equally well be indicated in this manner. On the right hand page, photographs of the trunks of trees, with the natural environment, are given. These indicate the typical bark and the comparative size, a foot rule being shown in each picture. The wood structure of at least one species of each genius is represented by a series of photomicrographs of transverse sections magnified fifteen diameters This interesting feature is designed to furnish a means of identifying woods by comparison with the aid of a pocket lens. The graphic idea is still further carried out by maps shaded so as to indicate the distribution of each species The remaining portion

*Published by the author, Low Ville, New York, price, post free, 8 dollars.

of each right hand page is devoted to a brief botanical and general description of the species concerned, with special reference to the habit of the tree, and to the quality, weight and uses of its timber.

A synopsis of the families and genera represented in this work with analytical keys leading to the species is given and the book closes with a comprehensive glossary and index.

The book represents some 208 species in this way, and when it is remembered that to obtain the photographs of the different parts, the author had to revisit the localities where each species grows several times, it will be seen what an enormous amount of hard field work was involved. The volume is of the utmost value to all who are interested in trees and we cannot praise too highly the thorough way in which it has been got up and published. Mr. Hough deserves the greatest credit for the production of this splendid volume which we strongly recommend to foresters, botanists, lumbermen, sportsmen and nature-students.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

METHODS OF TIGER SHOOTING.

Quot homines tot sententiæ.—Wherever sportsmen of tiger-shooting proclivities are gathered together, there will one hear expressed a variety of opinions as to the best, the most enjoyable or the most sportsmanlike way of tackling tigers. Compare, too, the pages written on the subject by the great hunters whose names are bywords among sportsmen, each advocates his own methods and extols their advantages. In the good old pre-Mutiny days, before stringent game laws became necessary, and when the ubiquitous tripper sportsman was still unknown, India was indeed a paradise for the big game hunter. Who can read the quaint tales of the "Old Forest Ranger" without a sensation that the scenes depicted therein took place in an India which we know not? Take the Doctor's favourite after-dinner story, for instance, "The daft like tiger hunt, wi' they twa wild birkies, at the falls of the Cauvery." A tiger had been shot at and missed, and made off to a deep ravine, where he lay up, being watched by a villager from

a convenient tree. Meanwhile, arrangements were made to catch the tiger in a net, bag him like a rabbit, and then spear him on foot—"a sport," remarks the Captain, "which is practised constantly in some parts of India; the most exciting style of sport you have yet seen." We can quite believe it. The story goes on to show how the huge nets were hung across every outlet by which it was possible for an animal to escape; the hunters, lying in ambush at a short distance, armed only with spears, are in readiness to rush in and despatch him before he can extricate himself from the meshes in which he is entangled. The cries of the beaters and the clatter of tomtoms at the far end of the ravine rouse the tiger from his lair, and on approaching one of the nets he suddenly stops having observed the obstacle. The sportsman immediately leaves his place of concealment, and advances, with his spear point lowered towards the net. The tiger, with eyes glowing, ears laid back, and hair bristling, utters a tremendous roar, and hurls himself at his adversary, becoming hopelessly entangled in the complicated mass of network. Then follows a description of how Charles went to work with the spear, how the spear shaft broke, and Charles belaboured the monster with the butt end. (Ye gods! as well set about an elephant with a cutting whip!) And then at last, as the tiger is on the point of freeing himself from the toils, he is given his quietus with a charge of buck shot. It was considered unsportsmanlike to use a rifle in the first instance, as the tiger would have no chance in the unequal contest.

The "Old Forest Ranger," in his own vivid language, makes a fine story of it, and who shall say that he drew the long-bow? Tiger netting was practised till a much later date in Southern India, and may be still for all I know; but the usual procedure was to have a dozen or twenty men hidden near the net, armed with good spears, with which to make short work of the tiger once he became enmeshed.

But the greatest differences of opinion arise over the merits of driving tigers with beaters on the one hand and night watching on the other. Sanderson is the great advocate of night watching. "In a shady green machan in some fine tree, watching at the cool

of the evening—that always bewitching hour in the Indian day—when jungle sounds alone break the stillness, and birds and animals seldom seen at other times steal forth and can be watched at leisure, whilst intense excitement is kept alive by the possibility of the tiger's appearance at any moment. I have often wondered how any one can consider being perched upon a tree under a blazing sun whilst a tiger is being driven towards him sport, and use the term poaching in reference to this. How many men have killed their forty or fifty tigers who have never succeeded in bagging one by watching—the fair outwitting of the subtle beast on his own ground? Give him who prefers the horn and tomtom system his diabolical appliances, his calorific post; but the solitary watch in the hushed hours of the evening for the lover of nature, for him who can feel the true romance and poetry of solitude in the jungles."

Well, yes; he is right in what he claims for night watching. The silent, solitary vigil, the weird hush that broods over the jungle, the occasional stealthy tread of some unseen animal, all are fascinating to one in tune with his surroundings. And then, of course, a tiger *may* come! But, oh, the long, weary hours I have spent at this same night watching, when needles and pins numbed my legs, and my back ached from sitting for so long in a cramped position, when the tiger or the panther would not come, and I longed for my camp bed and mosquito net, and a sound sleep *à belle étoile*. Personally, I have never been fortunate when night watching. It may have been my own fault, the result of incomplete arrangements—what you will. But I never want to do it again. Our actions, perhaps, are the necessary outcome of the circumstances in which we are placed. On my first arrival in India it was impressed on me that sitting up or night watching was poor sport. I was initiated into the art of beating by a past-master, and since then have had the good fortune to follow the game pretty regularly under most favourable circumstances, and count it the premier sport of India. Poaching you call it? Rubbish! It is an art to which a man may serve a lifelong apprenticeship, and still find that in practice he relies chiefly on

his trusty shikari. As a friend of long experience and exceptional knowledge once remarked to me, "I realise that the most I can ever attain to in tiger beating is to be able to rouse tired shikaris and beaters to one last effort when success appears to be impossible, and when I can see just the faintest glimmer of a chance remaining." The born shikari, with his keen sight and hearing, his unerring instinct, and a life spent in the jungle from early childhood, must always be able to give points to the amateur white man.

Consider for a moment a tiger beat from its genesis, and follow it through to the grand *finale*. First there is the tracking in the jungle to locate the tiger and discover his daily movements. A thorough knowledge of the whole topography of the country is necessary. You must know the windings of nullahs and streams, and where paths lead to, what is the tiger's probable run, and then you will be able to decide where the guns should be placed—that is, if you have knowledge and judgment. I have known a line of seven or eight guns placed so as to cover what appeared to be every possible line the tiger could take, and yet the cunning brute got through unseen. Placing the stops, marshalling the long line of beaters, directing them during the advance through heavy jungle and dense undergrowth where there are no distinctive landmarks so as to bring them up square to the guns—all this requires skill of a very high order. Something more than the poacher's art is necessary here, I think. "'The subtle beast must be outwitted on his own ground,' and it takes a good man to do it.

Why do sportsmen fail to secure tigers by beating? The answer is: want of experience, want of a really good shikari, failure to gain the confidence and cheerful help of the natives, and inability to think big enough and make big enough arrangements. Your field of vision and thought must range far beyond the actual jungle in which you are operating, and your 'bundobast' must be made on a corresponding scale. The whole crux of the argument is really in the last sentence, for it implies a lavish expenditure of money, and makes tiger shooting a very expensive amusement. Many a sportsman therefore, must perforce get his tigers by sitting up for them, thereby doing away with all the expenses of a beat.

In parts of Bengal and the Tarai beating with a long line of elephants is practised, and is the only way of getting tigers in the long grass where they lie up. This method is, of course, inapplicable to the dense jungles of Central and Southern India. But here the aid of a single trained elephant may be brought in, and the tiger followed and shot in his midday retreat. No sort of hunting, says Forsyth, requires more careful arrangements, greater knowledge of the habits of the animal, perseverance, and good shooting than the pursuit of the tiger by a single sportsman with a single elephant. Yes it must be fine sport! To mark down and track one's own game, corner him, and make him charge, and so end the encounter. Sharp, exciting work this! And truly, when you have argued all the different methods of attacking the tiger you have touched only the fringe of the subject, for in each method there are innumerable variations, every one of which is capable of wearing many different aspects in changing circumstances. Take it how you will, it is grand sport.—(By R. in *The Field.*)

EXTRACTS FROM OFFICIAL PAPERS.

THE IMPERIAL FOREST RESEARCH INSTITUTE.

RULES FOR THE GUIDANCE OF THE INSPECTOR-GENERAL OF FORESTS AND THE PRESIDENT AND MEMBERS OF THE IMPERIAL FOREST RESEARCH INSTITUTE IN CARRYING ON SPECIAL INVESTIGATIONS AND CORRESPONDENCE WITH LOCAL GOVERNMENTS AND LOCAL OFFICERS.

[*Enclosure to circular letter No.* 19-*F.*/213-2, *dated* 17*th August* 1908, *from the Under Secretary to the Government of India, R. and A. Department, to Local Governments and Administrations.*]

1. No investigation may be undertaken without the previous approval of the Inspector-General of Forests. When any member

of the Research Institute desires to undertake a new investigation, whether on his own initiative or on suggestions received from others, he should submit his proposal to the President of the Research Institute who, if he considers it desirable, will embody it in the annual programme

2. By the middle of September in each year, the President of the Research Institute will submit to the Inspector-General of Forests, a programme of the research work which he proposes should be undertaken during the next twelve months, showing the subjects of investigation proposed, and the localities in which it is intended to prosecute research The programme will be in the following form :—

(*a*) Proposed subject of investigation or research (to be definitely stated).

(*b*) Province and locality in which it is proposed to conduct the investigation.

(*c*) Approximate period of tour, short visits being arranged for separately by the President of the Research Institute.

(*d*) Dates on which visits are to be paid to students' camps.

(*e*) Remarks.

3. When the Inspector-General has approved of the initiation of an investigation, the President of the Research Institute will address the Local Governments concerned in order to obtain their approval of the proposed tour, assistance in carrying it out, and permission for the Research Officer to conduct correspondence on the subject with the local officers. When such permission has been accorded the Research Officer may, subject to any restrictions which the Local Government may in any case think it necessary to impose, correspond direct with Chief Conservators or Conservators as the case may be, in connection with such investigation, with the object of collecting information or specimens, or on matters of purely scientific interest and may also with the Chief Conservator's or Conservator's, as the case may be, special permission conduct such correspondence direct with Divisional Forest Officers under his control. The Research Officer should report to the Chief

Conservator or Conservator, as the case may be, the date of his actual arrival in the province.

NOTE.—In the case of a visit by a Research Officer to the Madras Presidency he should acquaint the Board of Revenue with the date and objects of his visit, and should also report to that authority his actual arrival in the province

4. When a Research Officer is on tour, he should keep the President of the Research Institute informed, in such forms as may be prescribed, of the progress of his tour, and should intimate to him at once any change of address. He should also keep the President of the Research Institute acquainted with the progress of any investigation in which he is engaged. The President of the Research Institute may, should he think it advisable, direct two or more experts to form a Committee for the elucidation of any particular subject of research.

5. Research Officers may, with the previous consent of the President of the Research Institute, conduct all necessary correspondence with private individuals, but they may not correspond direct with Local Governments or Administrations, and must be careful in communicating with officers of the Forest and other Departments to conduct their correspondence in accordance with the general or special orders of the Local Government concerned.

6 The President of the Research Institute should correspond direct with the Inspector General of Forests in connection with sanctioned investigations. The correspondence regarding each subject of investigation should be kept in a separate file

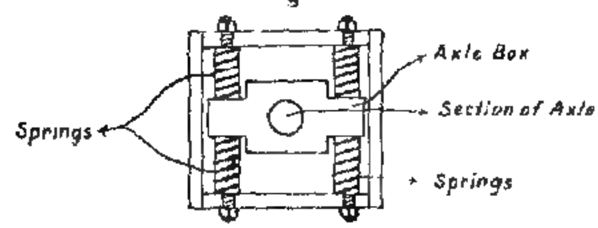
7. When an investigation has sufficiently advanced, or has been completed, the results will be embodied in a note, report or record, which will be submitted by the President of the Research Institute, if he considers it of sufficient importance, to the Inspector-General of Forests, so that the conclusions arrived at may be permanently recorded and published.

8. The researches of the Imperial Superintendent of Working-plans are primarily for the information of the Inspector-General of Forests. He will give no advice officially to Conservators of Forests, and he is not authorised in any way to interfere with the technical management of any forest.

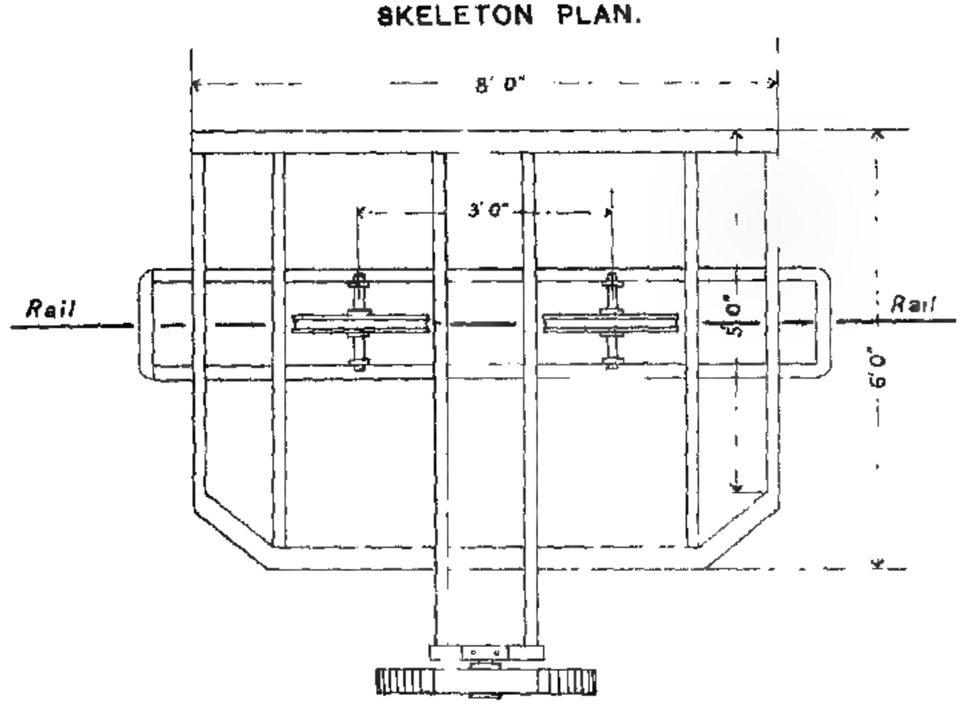
EWING'S MONORAIL SYSTEM
BALLAST CAR.

Side view of the spring axle box on the truck.

Fig 2



SKELETON PLAN.



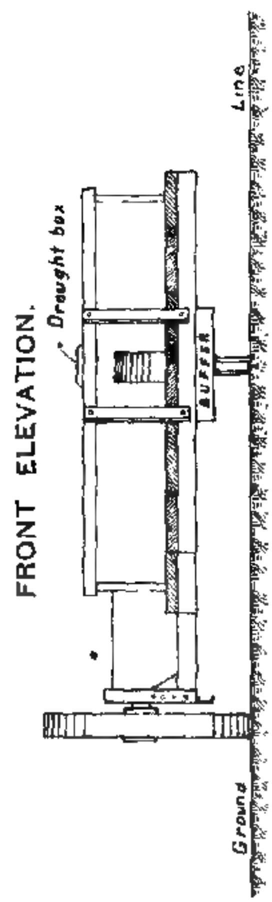


Photo.-Mechl. and Litho. Dept., Thomason College. Roorkee.

Zinco., February, 1909.—No. 4947-1.—925

VOLUME XXXV NUMBER 3

INDIAN FORESTER

MARCH, 1909.

FORESTRY EDUCATION IN AMERICA AND ELSEWHERE.

When America is convinced of the national importance of a project, it is carried through without delay ; when procrastination occurs, it is because the people have not arrived at a decision on the merits of the case. And this remark is *à propos* of the introduction of State Forestry into that country. At the close of the nineteenth century the state of affairs was that public attention had been attracted to the subject, and only eight years later there was a Forest Branch of the Agricultural Department in existence controlling a larger area of State forests than that in the Indian Empire. In 1900 the talented Pinchot family presented £30,000 for the establishment of a Department in the Yale University for instruction and research in Forestry ; they supplemented their gift by £10,000 three years later, and provided in the family estate at Mitford, land and buildings suitable for a summer school. The progress of Forestry in the popular estimation may be gauged from the simple fact that in 1905 the National Lumber Manufacturers' Association established a Chair of Applied Forestry and Lumbering at the Forest School, and have already subscribed £15,000 for this object.

The Yale Forest School contains a library of some 7,000 volumes, a reading room in which about 40 periodicals are available, a fitted botanical laboratory, including modern facilities for photo and microphotographic work, an herbarium with 6,000 mounted sheets and a large collection of fruits and seeds. There is a wood testing laboratory fully equipped with machinery and apparatus, a large collection of indigenous and exotic woods, while all surveying and other instruments are provided for the Forestry courses. The Forest students have the use of the University library, gymnasium and other institutions For practical instruction the New Haven Water Company have placed an area of about 9,000 acres at the disposal of the Forest School In the words of the report "a portion of this Forest has been under management since 1900 *so that there are already very instructive illustrations of silvicultural treatment*". Yet there are those who would have us believe that with 20 to 40 years' treatment in India, no such instructive illustrations are available, and even go so far as to assert that after 20 and more years' absence from the country, their minds' eyes can depict in a manner sufficiently accurate for instruction the stationary condition of those forests they abandoned a quarter of a century ago.

The Forest School is a graduate department of the Yale University. Graduates of all Universities, Colleges or Scientific Institutions of high standing are admitted on presentation of diplomas but they must have had courses in Elementary Botany, Geology, Inorganic Chemistry, Physics, Mathematics up to Trigonometry, Economics and Modern Languages. That is to say, they must have had a scientific education on the modern side and have proved that they have profited thereby. An undergraduate who later on intends to enter the Forest School is advised to take courses in Plant Physiology, Morphology, Mineralogy, Zoology, Physical Geography, Drawing, Organic Chemistry and Elementary Calculus. This is almost exactly what is wanted and what we hope we are coming to in English Forestry education, by the offer of probationerships in India to Honors graduates in Science from any University who will be able to regulate their graduate course accordingly, if they have

in view Forestry as a profession, and thereby shorten the course of subsequent special study. At the Yale University the full post-graduate course in Forestry lasts for two years, but it is possible for students of high standing to anticipate a certain amount of technical work and complete their post-graduate studies in one year. And so it certainly should be in England.

There are four terms in the Junior and three in the Senior years. The annual charge for tuition is £30 for the former and £25 for the latter. The frequent excursions cost less than £2 a year and the other travelling expenses of Senior students about £12; books and other material amount to about £7 a year. Tent hire in the summer term costs from £5 to £3, and board at the most £1 per week; a fee of £1 is charged for graduation. These rates, it is thought, will compare very favourably with the expenses incidental to the Coopers Hill College or Oxford training, and permit of students who are not well off to join a profession in which they may shine later on. The stipend recently sanctioned by the Secretary of State will aid much in this direction, and we trust that in future years Edinburgh and other Universities will be more largely represented in the Indian Forest Department.

A successful student of Yale, who must, as already pointed out, possess a Bachelor's degree, is granted the degree of Master of Forestry. He should be at this stage fully competent for any work he may wish to take up, for special facilities for study are given to those desiring to serve in the Tropics or those from foreign countries who wish to prepare themselves for the work of organisation in regions where Forestry has not yet been thoroughly established. Moreover, there are good opportunities for advanced specialised work and abundant facilities for research in all branches of Scientific Forestry.

It is thus evident that the Yale Forest student is placed in a position to study economically Forestry as a Science with special reference to the conditions of his native country and that having done so he can proceed to more advanced work relating, if so desired, to the conditions of other countries. English Forestry education has so far differed from this system, that at a great

expense it has permitted the applicant for Indian Forestry work to study Forestry with reference to the conditions in Europe where he has no intention of working, leaving him thereafter to adapt his knowledge to Indian conditions at the expense of the people of the country. The comparison is so disheartening that it need not be pursued. We must rest in hope that a radical change will be gradually introduced when the relative values of the two methods are better understood.

The officers of, or attached to, the Yale Forest School are numerous. The permanent staff consists of a President, a Director who is a Professor of Forestry, and three other Professors. There are 17 additional instructors and assistants who are however not whole-time officers but are engaged in the University in professional duties. The vast importance of locating any Indian Forest School in the vicinity of a University or College should not be overlooked in future; it is impossible with due economy to arrange that efficiency shall be compatible with isolation, and for this reason we anticipate that the Southern Indian School of Forestry when established at Coimbatore will possess important advantages over the former Dehra Forest School, in that its students will be able to attend the Agricultural College classes there and, besides thus lessening the labors of the Forest School staff, will be brought into more intimate connection with agriculture in which Indian Forestry will always remain an important factor. We must leave our readers to draw their own inferences outside the few most obvious we have touched upon in this necessarily concise description. The Yale Forest School now entertains 70 regular and 33 other students taking courses in various branches of Forestry, and our opening remark is peculiarly applicable to an Institution which has only been eight years in existence, and now, besides turning out excellent Foresters, furnishes valuable suggestions as to the methods which may be adopted in Forestry education both at home and in India with which we have been tinkering for some five times that period. Some difficulties must, it is true, always stand in our way in this country. We have no wealthy Indians or Europeans interested in a personal and practical extent in State Forestry. Our students must receive

instead of paying fees, but other disabilities can be lightened. We can remove from our Forest College the burden of elementary education of subordinates and with a clear conscience relegate this work to the Provinces, knowing that we shall by so doing have a larger choice of candidates of better social status, and that they will have the advantage of being trained in the forests where their life work is to be passed. And in England we can work towards encouraging the leading Universities to offer advantages for the study of Forestry and to grant degrees to those who excel therein, so that competition may be created for posts in a Department which we know is instrumental in aiding in the development of the Empire to a most marked degree.

SCIENTIFIC PAPERS.

NOTE ON THE ALLAPILLI MONORAIL TRAMWAY.*

Introduction.

The Allapilli forests lie 72 miles south-east of Chanda and an average distance of about 9 miles from the Pranhita river. They were bought from the zamindar of Ahiri in 1873. Ten years later an additional area was purchased in order to consolidate the Government estate. The quality of the locality is excellent and favourable for the growth of large timber, but the existing stock is very unsound and had been severely cut about before the purchase was effected.

Until quite recently Warora was the nearest railway station and most of the timber was carted 102 miles to a depôt there. In order to avoid carting any wastage and to supply sleepers to railway companies saw mills were erected at Allapilli in the early seventies. Transport to the mills from the forest and afterwards to Warora Depôt was carried out by means of bullock carts. The

* This paper was read by Mr. Donald at the Central Provinces Forest Conference at Nagpur in November 1908.

country is fairly level, except in the hills which rise abruptly from the plain and is eminently suitable for development by means of a tramway. At probably the most unfavourable period for the success of the scheme, because the fellings were drawing nearer and nearer to the mills and freight becomes relatively more expensive the shorter the lead, proposals for the introduction of a more up-to-date and cheaper system of transport from the forests to the mills than by country carts were called for by the Conservator of the Circle. This was in 1902.

The local officers were in favour of a monorail as being less expensive and less troublesome to shift about than a double line and accordingly estimates were called for. As the working for the next few years lay in areas within a radius of 4 miles from Allapilli a corresponding length of line was fixed on.

2. A firm submitted the following estimate:

Estimate and actual cost of the line.

Estimate for a monorail portable tramway (Caillet's).

	Rs.	Rs.
Four miles of flat-footed steel rails, 12 lbs. per yard, complete with scabbard fish plates and six large sole plates to each 16′ 6″ rail delivered at Warora Railway station including cost of four crossings and 4 portable ramps at Rs. 3,500 per mile ...	14,000	
10 special bogie trucks to carry 25 feet logs at Rs. 350 each.	3,500	17,500
The Divisional Forest Officer estimated :		
(*i*) The carriage from Warora to Allapilli (102 miles) at Rs. 17 per ton.	1,190	
(*ii*) The extra cost of points, sidings and breaks for trucks at Rs. 600.	600	
(*iii*) The cost of laying on an existing cart track, levelling and bridging at Rs. 350 per mile.	1,400	
		3,190
		20,690

3. What was actually bought was—	Rs.	Rs.
4 miles of Caillet's patent monorail tramway rails, 14 lbs., inclusive of points and crossings consisting of 1,271 steel flanged rails 16' 6" × 14 lbs.		
1,272 pairs fish-plates.		
6,400 rail chairs.		
12,350 bolts and nuts	10,180	
6 special bogie trucks to carry logs 25 feet long at Rs. 350 each.	2,100	
1 jack screw	34	
12 additional wheels and steel channel iron ...	74	
Royalty on Ewings' patent balance wheel (subsequently affixed).	900	13,288
Carriage from Bombay to Allapilli ...	2,322	
Laying of four miles	594	
		2,916
Or per mile Rs. 4,051		16,204

The line was laid during December 1902

4. It is instructive to compare the original estimate by the firm and the figure to which they eventually agreed. They estimated Rs. 14,000 for 12 lbs. rails at Warora, add cartage to Allapilli (Rs. 1,190) and the total is Rs. 15,190. They actually supplied 14lbs. rails f. o. r., Bombay, at Rs. 10,180 and carriage to Allapilli from Bombay amounted to Rs. 2,322, or a total of Rs 12,502, a reduction of Rs. 2,688, although the rails were 2 lbs heavier equivalent to Rs. 2,532, so the total 'softening' of the original estimate was Rs. 4,854.

They offered to lay the line for Rs. 300 per mile or a total of Rs. 1,200. The actual cost of the work done departmentally was Rs. 594.

The local officers were in favour of trucks on the Ewing system, *i.e.*, with a balance wheel. The firm considered Caillet's to be the more suitable and built them accordingly. The first trials showed that the Caillet system was impracticable and the trucks

had to be converted into the Ewing pattern. Expert advice is most essential, but it should be obtained from an independent and unbiassed source, and the first quotation is not necessarily the lowest.

5. From the papers available the question of a double line does not appear to have been sufficiently if at all, considered.

General description of the plant.

6. The monorail tramway as purchased consisted of a single line of rail, steadied by iron sole plates 10" × 5" affixed every three feet laid flat along a roughly levelled track without ballast and without sleepers.

The laying was simplicity itself and cost only Rs. 150 per mile. No skilled labour was required and curves had not to be laid out with the mathematical correctness required by a double line.

7. The trucks were double bogies connected by a heavy channel iron frame and provided with flat sheets projecting down almost to the ground at either side of each bogie to bear the weight of the truck when not in an upright position and to prevent it coming right over on to the frame. The wheels, two sets placed tandemwise, were double flanged and sat very loosely on the rail. On the top of the frame were two upward curved pieces of channel iron, one over each bogie, to support the logs. From one side of the truck came a flattish S curved iron to the end of which was attached the bullock yoke. It was presumed by the Engineer who designed this attachment that the bullocks would be able to bear the strain of balancing the load in addition to dragging it. Vain presumption! The unfortunate animals when the truck tilted away from them were hoisted into the air by their neck ropes and nearly strangled, a position however that compared favourably with that in which they found themselves when the load tilted towards them Pinned to the ground by their yokes and by the S-shaped iron with a 1½-ton load to keep them there their state was indeed serious and painful until the united efforts of several men succeeded in unloading part of the burden and in restoring the equilibrium of the truck.

A more impracticable method of traction, side traction at that, could scarcely have been devised.

8. The local officers at once hit on the device of affixing a large cart-wheel to each bogie which would bear part of the weight of the load, in theory 10 per cent, and practically converted the mono-rail truck into a hybrid—a cross between a cart and a truck with four wheels tandem on the rail and two wheels tandem on the road.

The lateral yoke attachment was done away with and a pole with a yoke was fixed to a ring in front and the bullocks had the load behind them instead of along side or on the top of them. The trucks were a little less handy than before as they could only now be loaded from one side, and of course required more room and a prepared track for the cart-wheels; but they were innocuous.

These balance wheels were found to have been patented by Charles Ewing and a royalty of Rs. 150 per truck had to be paid.

9. In 1904 the cast iron wheels originally supplied began to give a lot of trouble. Owing to the weight of the load falling partly on the balance wheels and partly on the bogies in proportions varying greatly with the inequalities in the road and to careless loading the centre of gravity was well to the balance-wheel side of the line; the pole being attached to the middle of the end of the frame, there was always a lot of friction that should have been unnecessary. The question of converting the line into a double tramway was then raised; but the Divisional Forest Officer proposed that it should be given another trial with wheels having the treads of chilled steel instead of cast iron. This innovation was adopted and has proved to be very successful. The line has worked very satisfactorily ever since.

10. In November 1905 it was relaid on a new alignment in order to tap a fresh group of coupes. The removal, the making of the fresh road with bridges and cuttings and the laying down of the line cost Rs. 400 or Rs. 100 per mile.

11. The bridges over small nalas are made of "furrahs," or the side pieces of logs, supported on stout poles placed transversely to the length of the road and in turn supported by forked uprights sunk into the bank or bed of the stream. Dry stone buttresses

and bed complete a very simple and cheap type that is strong and lasting. Larger nalas are negotiated by temporary Irish bridges. The bottom layer is composed of large logs placed parallel to the banks at intervals of 3 feet. This allows of sufficient waterway for the small flow of water in such streams in November or after a heavy shower in the cold weather. On the top of the logs are placed furrahs and then as much earth and murram as is necessary to bring the road up to the required level. Just before the rains each year the timber is removed and placed in safety on the bank.

12. Except on the bridges, where murram is used, earth is used for packing and for the cart-wheel track. The present alignment lies for the greater part through black cotton and a track on either side of the rail is kept in rough repair as there is cart traffic over the road and also as it is convenient to load some trucks on one side and some on the other. Bullocks are not strong enough to draw a loaded truck. A good pair of buffaloes can draw 1½ tons 1¾—1½ miles per hour. The gradients are light. For a short distance up one nala bank there is a rise of 1 in 17, but this is the only severe one in the whole distance.

Traffic and capability of the line.

13. The traffic consisted of teak logs up to about 1,300 tons over an average distance of 3 miles or 3,900, say with fuel 4,000, ton miles. The capability of the line, *i.e.*, the maximum quantity of material that the line could carry in the year may be calculated as follows: The line could be open from November 1st to the 15th of June or 7½ months; allowing for holidays, say, 6 months or 180 actual working days. Each of the 6 trucks could make one trip over the 4 miles carrying 1½ tons and return empty again in one day. That is, the 6 trucks would carry 6 × 1½ × 4 = 36 ton miles per day or in 180 days a working year, the line could carry 6,480 ton miles.

Financial aspect of the line.

14. During the first four years that the line was working 287,389 cubic feet or 5,748 tons or 4,311 ton miles per annum (nearly double the normal quantity was extracted during the first two years owing to short removals in previous years) were brought by

the monorail to the mills at a cost of Rs. 22,465 or Rs. $\frac{22,465}{5,748} \times 3 =$ Rs. 1-4-10 per ton mile.

Had carts been employed the total cost would have been Rs. 32,930 or Rs. $\frac{32,930}{5,748} \times 3 =$ Rs. 1-14-7 per ton mile. These figures are given in detail below and include the cost of bringing from the forest to the rail, loading, unloading, depreciation (not interest, which if calculated at 3½ per cent on the capital would increase the rate per ton mile by Re. 0-2-1 or to Rs. 1-5-11) on all stock, live or dead, employed.

The traffic being so little and the distance so short accounts for the high rate :—

	1903-04.	1904-05.	1905-06.	1906-07.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.
Pay of coolies ..	1,606	1,459	330	405	3,800
Repairs and up-keep of monorail including laying down tramway on new lines, royalty, etc.	357	1,185	494	148	2,184
Feed and keep of elephant and cattle.	2,971	2,998	1,733	2,437	10,139
Establishment ...	156	158	136	144	594
Depreciation at 10 per cent on capital cost	1,612	1,450	1,305	1,521	5,888
10 per cent value of elephants and cattle.	200	175	120	240	735
Total Expenditure ..	6,902	7,425	4,118	4,895	23,340
Less cost of other works ...	...	..	...	875	875
Net cost by monorail ..	6,902	7,425	4,118	4,020	22,465
	C.ft.	C.ft.	C.ft.	C.ft.	C.ft.
Total number of cubic feet landed at the mills by the monorail.	98,242	127,070	25,418	36,659	287,389
	Rs.	Rs.	Rs.	Rs.	Rs.
Cost of above if carried otherwise at Re. 0-1-10 per c. f. (paragraph 79 of A. R. for 1903-04).	11,257	14,560	2,913	4,200	32,930
Profit on working of monorail.	...	...	...	...	10,465

Points in connection with the working of the line.

15. The facility with which it can be taken up and laid down is undoubtedly its chief advantage. Only a minimum of skilled labour is required and the track need not be specially prepared beyond making the road for the wheel, level with the bottom of the rails.

Except in moist places no sleepers were used ; the sole plates rested directly on the ground.

16. *In the exploitation of coupes the line has been invaluable*, as it can be laid to wherever large trees are numerous. Elephants could then drag the logs direct to the rail head without any carting having to be done at al..

17. *In order to reduce friction* the wheel tread should be twice the *breadth of the rail-head. Also the drawing pole should be fixed a* little to the balance-wheel side of the centre of the bogie and a murram or metal track should be made for the balance wheels.

18. The trucks, primarily intended to carry logs, have also been used for fuel. About three cart loads of fuel go to one truck

19. The very clumsy and unwieldy nature of the frame with the balance wheel attachment compares unfavourably with the light double rail bogies now obtainable for this class of work.

Further the double rail requires no more pucca road than the existing pattern of monorail with its two large balance wheels. A light double line for bullock and hand traction recently put down in Assam by Mr. Perrée, Deputy Conservator of Forests, cost Rs. 6,000 per mile complete with rolling stock inclusive of carriage and laying.

The difference in the cost of the monorail, *viz.*, Rs. 1,850 per mile, *would probably be saved after a year or so by the increased* carrying power and lesser traction. If on a double line one pair of buffaloes could carry *2½ tons against 1½ on the monorail*, the additional expenditure would be more than compensated.

20. To summarise, the disadvantages of the monorail are :—

(i) It is dangerous and impracticable for unskilled labour without the use of the balance wheel.

(ii) With the balance wheel it can be loaded only from one side.

(iii) The large amount of friction.

(iv) The centre of the bogie to which the pole of the dragging yoke is fixed is not in the axis of the centre of gravity which lies between the bogie wheels and the balance wheel, and this causes additional friction between the wheel flanges and the rail, besides putting considerable strain on the bearings and on the line itself.

(v) The frequency of derailments.

(vi) Lower carrying power compared to a double rail.

(vii) If it is necessary to load some trucks on one side and some on another an additional track must be levelled for the balance wheel on the other side.

(viii) Owing to (iv) it is difficult to make trains of the trucks unless the balance wheels are on opposite sides, when these levelled tracks as in (vii) would be required

21. The advantages are :

(i) Cheapness.

(ii) Portability—easy to take up and to lay down.

(iii) Can go round sharper curves than a double rail, though with the addition of the balance wheels this difference is not so marked.

(iv) The actual line interferes very little with other traffic.

(v) No skilled labour is required.

22. Taking everything into consideration a portable 10 or 12lbs. double rail would probably have been the more satisfactory and in the end cheaper. Further, if a tramway is to be laid, a monorail means only half a tramway and half a cart. A heavier rail, 14 lbs. at least, is required than for a double line for the same traffic. For a double line sleepers are required, but the Forest Department can obtain these very cheaply and on the spot. One man can barely push an empty monorail truck of a carrying capacity of 1½ tons A child could push two double line bogies of twice the capacity with ease.

23. The Allapilli tramway scheme was for a very small amount of traffic and the line has been successful and has paid its way. I append however, a note on a monorail tramway 20 miles

long put down by a manganese company and worked to its utmost capacity. Had a double line been laid originally the agent estimated he would have saved his company a matter of Rs. 70,000 during the two years that the line had been working. Another note, by Major Edgehill, R.E., on the Jubbulpore Gun Carriage Factory Monorail, is also given below.

24. For no kind of forest work would I recommend a monorail tramway. If the traffic is light a 10 lb. double line with hand or bullock haulage will be equally portable and of very little additional cost to begin with. The Goalpara line in Assam cost Rs. 6,000 per mile, with 14 lb. rails and with hand traction carried about 17,000 tons miles at a rate of under Re. 0-5-0 (includes depreciation and interest). For heavier traffic, say 30,000 ton miles, it would probably pay to have 18-lb. rails and 20 H.-P. engine. The plant would have a capacity of about 84,000 ton miles in 7 months. But for the transport of logs or other material which by its nature is difficult to accurately balance when loading a monorail tramway is the most impracticable system one could choose.

Hints on considering tramway schemes.

25. In considering the question of laying down a tramway plant the following headings may be of assistance :—

(1) The amount of traffic and what development is likely to take place.

(2) The present cost of transport in figures per ton mile.

(3) Expert advice from independent sources as to the best way of dealing with the traffic.

(4) Personal inspection of existing lines with a view to gaining experience in the laying down and work of tramways is essential to the framing of a reliable estimate and to obtain the best results from the very beginning.

(5) Whether by altering the working-plan the line can be more suitably served than under the existing sequence of coupes.

(6) Maximum loads, wheel pressures, kind of sleepers and the distance between them.

(7) Whether the amount of traffic justifies steam haulage.

(8) An estimate from a firm or from firms for the plant required.

(9) An estimate of the carriage to the site, the cost of survey and laying.

(10) An estimate of the cost of extracting by means of the line the produce available with details of working expenses including interest on the capital expenditure (8 and 9) and depreciation on all stock. To begin with the line may not have to be worked for the whole season.

(11) The time that the line will remain on each alignment and the cost of removal and relaying.

(12) Maps showing the areas to be worked and, roughly, the various alignments.

Concluding remarks.

26. There can be not doubt that in the Central Provinces the question of tramways has not received the attention which it merits. A glance at the table below will give food for thought and possibly for action :—

Name of line or route.	Length in miles	Amount of traffic in ton miles.	Cost per ton mile. By carts.	Cost per ton mile. By tram.	Remarks.
			Rs. a. p.	Rs. a. p.	
1. Allapilli monorail	4	(*a*) 4,000	1 14 7	1 5 11	(*a*) About 60% of the capability.
2. Shivrajpur monorail	20	(*b*)		0 7 8	(*b*) Line worked with 60 trucks up to its maximum capability bullock traction.
3. Goalpara 2′ gauge	9¼	(*c*) 17,000	0 9 0	0 4 11	(*c*) Figures approximate.
4 Central Indian Mining Company's 2′ gauge.	30	(*d*)	..	0 0 9	(*d*) Line worked with several engines to its maximum capability.
5. Allapilli Warora ..	102	50,000	0 3 0	..	Rates for sawn timber.
6. Allapilli Chanda ..	72	.	0 3 6		
7 Allapilli-Ballapur	62	..	0 3 10	.	
8. Compart. 2 to Wangapilli.	8	(*e*) 32,000	0 9 3	...	(*e*) Teak logs.

NOTE.—The figures under (*a*) include the cost of extraction to the line.

27. Where forests are worked by contractors or coupes are sold standing a royalty could be charged per truck load carried. It is a mistaken policy of *laissez faire* to leave works of improvement requiring a large outlay of capital to a man who may only be interested in the forest for a year or two. In order to get the best price for produce Government should provide the capital for the cheapest method of getting it to the market, or to state the case differently, the aim should be to greatly increase the bulk of forest produce sold, up to the possibility of the forests, and to give the consumer his timber and fuel, but especially his fuel—for on this hinge many problems of agriculture and of grazing of vital importance to the State—at the lowest price possible. In many cases transport by tramways would prove to be a very great saving on that by country carts. In each division the question should be taken up and in order to save the re-duplication of labour it should be advisable to place an officer on special duty in these Provinces to examine existing methods and where necessary to draw up schemes for better and cheaper transport.

J. DONALD,

The 7th October 1908. *Offg. Deputy Conservator of Forests.*

NOTE ON THE MONORAIL TRAMWAY AT THE JUBBULPORE GUN CARRIAGE FACTORY, 1901 02.

I.—General History

1. An estimate was sanctioned for—

		Rs.
10 miles of rails at	... ...	30,000
20 tip trucks	. .. ...	3,500
1 log wagon bogie at	... ...	225
1 platform wagon at	. ...	335
Points at	... .	400
	Total ..	34,460

2. The line being experimental, less was tried, 6 tip trucks, a log wagon bogie, a bullock and a hand platform truck on the Caillet system and one platform wagon on the Ewing system were got; and two miles of line laid from the Railway Goods yard to the Factory.

3. This line has been continuously worked, almost entirely by hand labour, which could load as well as propel. It has been of great use in checking attempts to raise cartage rates, and supplementing bullock cartage when scarce.

4. At the request of the brick contractor (who was to pay hire and make the subgrade) rails (4 miles) for a double line to the brickfields were afterwards obtained. In the meanwhile, this man obtained the cartage contract permitting him the use of the laid line. After practical experience of the worries given by the labour working it, he decided against using the brickfield line.

5. On lines laid for levelling, the trucking by untrained labour worked out more costly than basket work and was abandoned.

II. Working cost compared with ordinary transport.

(*a*) CARTAGE LINE.

6. Three men per truck at 3 annas 6 pies per day, trucking 9 cwt. in 3 trips (12 miles) give a rate, allowing for supervision, of 11 pies per maund.

7. The use of women did not cheapen this. A man was necessary to hold the handle, and 4 to 5 women besides per truck.

8. This is cheaper than carting; but, at times of pressure, the line could not carry more than 3 tons a day with the trucks and labour available, and required supplementing.

(*b*) LEVELLING LINE.

9. Three untrained men took one truck load of 13 baskets in the time they or 3 strong women could carry 12. Allowing for basket carriers between diggers and trucks and labour to clear line and shift rails, trucking cost more than carrying.

III.—Saving effected by tramway.

10. Before the cartage line was laid, 2,213 maunds were carried for Rs. 189-4-0 or 1·37 annas per maund; but for the Sub-Divisional Officer's personal engagement and close supervision of the cartage for most of this job, it would have been much more.

11. Since laying, the cartage contract rate as obtained by open invitation allowing the use of the line to the contractor, is Re. 0-1-0 per maund.

12. At least 11,700 maunds have since been moved by rail or road between the terminals of the line.

13. The saving (at 0·37 anna only per maund) is Rs. 283 for one year, giving 4 per cent. return on a capital cost Rs. 7,275 of actual plant used.

14. This total does not include indirect savings, or saving on cartage of materials (of large amount) debited direct to estimates, and of which no detail of weights can be traced.

IV.—Causes of small profits.

(*a*) LESS MATERIALS CARTED THAN ESTIMATED.

15. The whole of the sal and teak logs used have been delivered by the Forest Department by road direct to site.

16. The site, when opened up, was found to be well supplied with good building limestone.

17. The brick contractor objecting to use the line for his bricks (as the cartage line labour already gave more trouble than he cared for) no line was laid to the brickfields.

(*b*) DISLIKE OF COOLIES FOR THE CAILLET SYSTEM

18. This system requires trained labour. The balancing of these trucks requires continuous attention, which worry uneducated labour.

19. Careless moving of heavy loads is dangerous. One bad accident at least occurred with them.

20. If two coolies by pushing one on each side of a truck tried to share the lift or loading strains caused by the rocking of the truck, they simply gave mutual discomfort.

21. Women specially dislike these trucks and have struck work rather than use them.

(*c*) INABILITY TO USE THE LINE FOR PROPER LEVELLING.

22. Proper and economical tram levelling can only be done when the cutting is carried towards from the intersection of the levelled plane with the natural ground, so that the trucks can be filled by diggers and fillers.

23. Large importation of labour at reasonable rates was not possible owing to other large works in progress in India. The best use had to be made of what was available.

24. The sites of many buildings in the factory require levelling before construction can begin. The labour had to be concentrated on these, so that the levelling excavation was in more or less deep holes requiring for tram work extra basket carriers between the trucks and fillers.

24. Every man was wanted to dig; the women were all but useless with the trucks so the tram was not continued.

V.—Points found in favour of Monorail Line

26. Quick laying by unskilled labour.

27. Working possible with very sharp curves, bent rails and bad laying.

28. A minimum nuisance to ordinary traffic over the same ground.

29. Half the cost of a 2-rail line.

NOTE.—In the following remarks on the two systems of trucks used, no notice is taken of the remediable structural defects of the particular trucks tried.

VI.—Caillet Trucks

(*a*) ADVANTAGES.

30. Cannot "take charge" down an incline.

(*b*) DISADVANTAGES.

31. Requires trained labour.

32. Wearisome to hand labour.

33. Dangerous with careless handling.

34. The side propulsion, causing—

(*i*) Strain on connections between truck and motive power.

(*ii*) Thrust of wheel flanges against rail, adding to motive power required.

(*iii*) The combined width of truck and motive power taking up more way than any other system.

35. Each truck requiring an animal or coolie to keep it balanced, they cannot be made into trains, when large motive power (elephants, teams of animals, steam road engines) is available.

36. A truck adapted for one class of motive power requires complete alteration of the connecting frame work before it can be used for another.

37. In levelling, the low legs (on which a truck is supported when at rest) catch lumpy filling and require clearance.

VII.—Ewing Trucks

(*a*) ADVANTAGES.

38. Can be used by untrained labour.

39. Requires moderate width of track.

40. Can be made into trains.

41. Can be moved by any system of traction available without alterations.

(*b*) DISADVANTAGES.

42. The road wheel—

(i) Makes traction a little heavier than with other systems.

(ii) Interferes with loading on one side.

Necessitates a larger radius of curve in the line (for bogie trucks only) than the Caillet.

VIII.—Probable best arrangements of tram system.

43. The result of the trial of the two systems showed that the Ewing was best for carriage. But for the fact the broad gauge siding was about to be begun, more Ewing trucks would have been got.

44. The Ewing was not adopted for levelling and could not be tried. Possibly the extra traction of the road wheel over the uneven filling would have given unsatisfactory results.

45. Until this is to be settled practically, a 2 rail line appears best in such work, though the monorail line is far more flexible and suitable for unskilled labour to lay and shift.

A NOTE ON THE SHIVRAJPUR MONORAIL TRAMWAY.

1. Twenty miles of monorail tramway with Ewing's patent trucks were laid down for manganese works.

2. Eighteen pound rails were used and it was found that 2½" section rails were better than 2¾" section as with the latter the wheel flanges were [illegible] of the fishplate bolts.

3. Sixty trucks were purchased at a cost of about Rs. 500 apiece. They were to carry six tons but their construction was badly designed and the materials used of an inferior quality, so the bill for repairs and renewals was soon a pretty heavy one.

4. With such heavy loads the sole plates crumpled up and it was found necessary to use sleepers, a size 18" × [illegible] × 9" proving most suitable, placed three feet apart centre to centre, and well ballasted with [illegible].

5. The average rate for loaded trucks with bullock haulage is from 1½ to 2 miles per hour and the cost so far has been prohibitive (Re. 0-7-8 per ton mile) owing to

almost every detail having to be re-designed by the purchasers, the consequent delays, the high rates for fodder and heavy mortality among the company's cattle.

6. The friction generated, even after the road surface has been most carefully levelled, more carefully than would be required for a double line, makes draught very heavy.

7. The cost of the line and material, in fair working order as it stands now, is just short of Rs. 9,500 per mile. This includes laying, initial repairs, renewals, and alterations due to bad workmanship and all road work.

8. Many advantages were claimed for the monorail, *viz.*, cheapness, rapidity of laying, skilled labour not required, could be laid along "kutcha" roads without sleepers and without ballast and that friction was reduced to a minimum; but it has proved most unsatisfactory and not up to the specification. It is about to be converted into a double rail.

9. The sketch given in Plate 8 shows the method of fixing the balance wheel. It was found necessary to put in the extra support shown (by a single horizontal line) as the wheel bracket tended to bend in towards the truck.

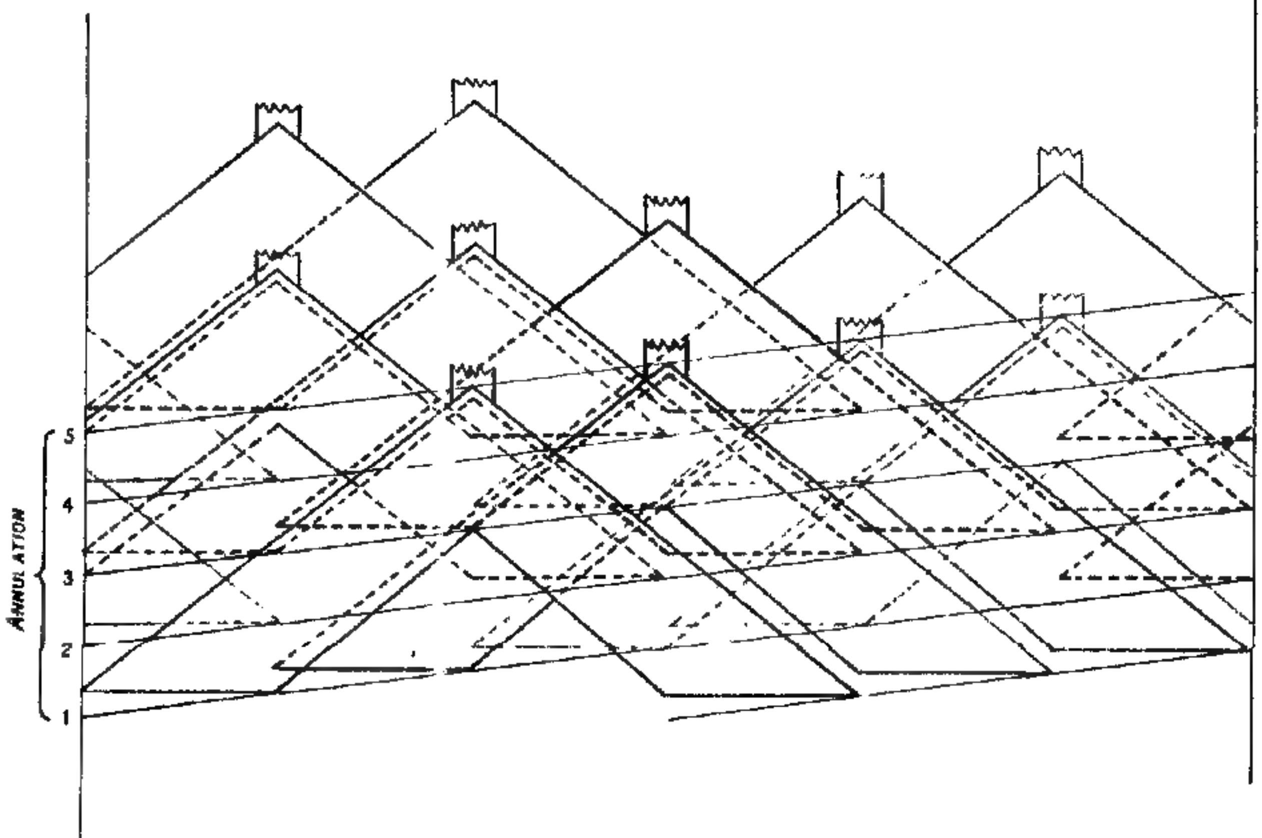
ORIGINAL ARTICLES.

SOME NOTES ON PALMS.

Many years ago, in the middle nineties, I sent a query to the *Indian Forester* asking whether any information could be given in respect of the age of maturity of Palmyra (*Borassus flabellifer*) and pointed out that, whereas the ordinary inhabitants would often say that they arrived at that stage about the age of 25 years, there were indications which induced me to believe that a very much longer period was necessary, quoting the instance of the plantation of Mr. Orr, a former Collector in the old Kistna District, over 60 years old where the trees did not appear to be much more than half grown; and pointing out that it would appear to be possible to estimate the age to some extent by the number of the annulations on the exterior of the stem. As apparently three leaf-bases form a spiral annulation, twelve leaves are developed in the course of a year, and consequently four annulations correspond to a year's growth.

No reply was elicited; but the matter has received my attention between then and now, and it may perhaps be useful to place on

Diagram showing arrangement of Palmyra leaf sheaths on the trunk and Annulations left by bases of leaf sheaths.



PARTIAL ANNULATION

Trunk opened out flat

———	Leaf	Sheaths	Nos.	1 · 7 13
———	,,	,,	,,	2 · 8
———	,,	,,	,,	3 · 9
	,,	,,	,,	4 · 10
	,,	,,	,,	5 11
———	,,	,,	,,	6 · 12

Photo.-Mechl. and Litho. Dept., Thomason College, Roorkee.

Zinco., February, 1909.—No. 4947-925

record the observations noted. But before proceeding, it must be remarked that the ordinary ideas which prevail about the quick growth of Palmyras seem equally prevalent in regard to the wild date (*Phœnix sylvistris*). In Dr. Watt's Dictionary of Economic Products, Vol. VI, Part I, page 210, it is stated that in Jessore the wild date is quite ready for tapping in seven years, but that there are very many who have not the patience to wait for the expiration of the full seven years. If this is the actual rate of growth in Jessore, then apparently there must be an enormous difference in the rate of growth in different localities; and to some extent this appears to be also the case with Palmyras.

Before entering, however, into the question of the rate of growth, it will be as well to mention a few observations in respect of the mode of growth. In an unpublished contribution that I sent to the *Indian Forester* in 1898, I pointed out that, in a certain locality of the Nallamalai Hills of Kurnool District, I found a large grove of the Indian Sago Palm (*Caryota urens*), where every stage of growth from the smallest seedling to the over-mature and decaying trees was to be found; and that on pulling up some of the young seedlings I found that, to all intents and purposes, for every rootlet there was a leaf; I say "to all intents and purposes" because, although in the majority of instances this was the case, yet a very few seedlings were found with either one leaf or one rootlet in excess. Further, it also appeared as if every leaf corresponded with a rootlet on the opposite side of the principal axis of the plant, except the most newly formed when both took the line of the principal axis, straight up and down. Since then I have noticed this fact in all palms and in many monocotyledons (*e.g.*, aroids, grasses, etc.); the latest example was about a month ago in the case of a young cocoanut (*Cocos nucifera*), which the owner told me was about five or six months old, and which had five rootlets and five leaves. If we examine any palm whatever we always find that the newest unexpanded leaf comes from the top of the central axis; and as it expands it is pushed on one side by a newly developing leaf bud (unexpanded leaf); that the position of the leaf stalks of the last three leaves forms a triangle with the

new leaf-bud as centre, and of the last six leaves forms two triangles crossing one another in such a way that the apices of one triangle fall about the centre of the sides of the other triangle.

In many botanical works we read that the fibro-vascular bundles which pas fro m the leaf sheath into the stem form an arched curve passing from outside the false bark towards the centre of the stem and outwards again towards the circumference; although true in a way, this does not seem to me to give quite a correct idea, as from what has been said, the growing point from which these fibro-vascular bundles start is not on the outside but in the centre of the apex of the stem, and from these the leaf bundles are thrust outwards by new growth upwards and on one side, and the root bundles downwards and on the other side, that is to say the growth is not from outwards inwards (endogenous) but from inwards outwards (quasi-acrogenous).

Since the beginning of August I have been watching the development of leaves of many kinds of palms, and find that a fresh leaf bud is formed every month in the central axis, and when that forms the next oldest is pushed on one side and begins to expand, and this was constant in all kinds, date, palmyra, cocoanut, sago palm, betel palm (*Areca*) and several exotics (*Arenga*, *Livistona*, etc), so that the rate of development of twelve leaves a year appears to be constant.

In Palmyras the leaf sheaths are very broad at the base, and, after a time, split and form an open triangle with the leaf stalk. From one side of the base of the leaf sheath to the other side is usually about two-thirds of the way round the stem, each portion of the split base being about one-sixth, leaving one-third the girth in the open triangle. The split bases of the next two leaves, each one-sixth of the circumference, fill up the open triangle behind; and the left half base of the fourth and tenth leaves in the spiral comes immediately behind but above the right half base of the first leaf, and the right half bases of the seventh and thirteenth bases comes immediately behind the right half base of the first leaf, as shewn in the diagram (Plate 9). These half-leaf bases form a more or less continuous spiral annulation when they fall,

and there are four annulations to the twelve leaves, that is to say, to one year's growth.

With the assistance of Ranger K. Rama Rao, of Sarvasiddhi Range in Vizagapatam District, the annulations on ten Palmyras were counted at my camp at Venkatapuram, and gave the results noted in the margin. Sir D. Brandis in his "Indian Trees" tells us :—"Trunk attains 100 ft and 2 feet diameter near the ground, with a dense mass of long rootlets." If we take trees of that height and the average rate of growth shown in the marginal table, it means that mature trees would take 300 years to grow.

Tree No.	Height in feet.	No. of annulations.	Years old at 4 annulations per year
1	46½	498	124½
2	43⅓	545	136⅓
3	27	364	91
4	16¾	280	70
5	22¾	337	84¼
6	20¾	283	70¾
7	26½	340	85
8	25¼	283	70¾
9	26½	315	78¾
10	26	310	77½
Average per foot		12·66	3

These annulations alone do not give the full age of a tree, but only the length of time it has taken to grow from the time it began to develop an above-ground stem. All palms before throwing up an above-ground stem have to develop first the full thickness of the mature stem below ground. In the above quotation from Sir D. Brandis it is seen that the trunk near the ground attains 2 feet in diameter; and the whole of this had to be developed first before the upward growth commences in earnest. In Kupgal Reserve of the Bellary District, Rai Bahadur M. R. Ry. M. Muttanah Garu (formerly District Forest Officer of that District, now Conservator of Forests in Mysore) put down some Palmyras about the year 1895; these have not yet developed an above-ground stem although they are 13 years old; similarly about 1891, Rao Bahadur M. R. Ry. V. Alwar Chetty Garu put down some in Bapatla Range of the present Guntur District, these likewise, although about 17 years old, have no above-ground stem; on our way to Venkatapuram in Vizagapatam District some Palmyras sown four years ago had not even any appearance of an under-ground stem, but, on the other hand, some other trees in that vicinity were beginning

to put forth an above ground stem, and they only had from 30 to 40 leaves, or 2½ to 3½ years old.

Dates do not ordinarily attain such large dimensions of stem as Palmyras, about 1 foot diameter, exclusive of leaf bases being about the ordinary size, nevertheless they probably take longer to develop; in Bellary District the leaves of two trees which seemed just about to form their above-ground stem, were counted, and one numbered 140 the other 247 leaves, equivalent to just under 12 and just over 20 years. Leaf counting is not altogether satisfactory, as often the lower leaves die off, and if close to the ground are, when dead, consumed by white ants. Some edible dates (*Phœnix dactylifera*) in the same district put down 15 years ago have only about 3 feet of defined above-ground stem. In the garden of a native gentleman of Vizagapatam, Mr. Narrain Murti Pantulu, a very large number of cocoanuts were put down between 5 and 6 years ago; one or two are beginning to form a defined stem, but by far the greater number had not even the semblance of one.

The interior of palms consists of a mass of cellular tissue which tends to expand more or less equally in all directions unless there is something firmer to arrest it, in the case of palms this arrestation is caused by the fibrovascular bundles of the leaf sheaths. The leaf sheaths have a certain amount of expansive power, but it is very slight as compared with this cellular tissue; and it would seem that the cellular tissue expands laterally so long as these sheaths can expand, and until they have made the fibro vascular mass known as the false bark; after that the cellular tissue must perforce expand upwards. From what has been said above it would seem that the number of years required to form the underground stem in Palmyras at least, and also in the case of wild dates, if what is recorded in Dr. Watt's Dictionary of Economic Products is correct, is very variable from two to three years up to fifteen or twenty. It may be, and indeed it seems to be, that the dampness or dryness of the climate has something to do with this growth taking longer in some districts than in others, possibly the cellular tissue does not develop so quickly in the drier tracts as there is less moisture to fill the cells; and consequently the space limit fixed by the leaf

sheaths, which does not vary considerably, takes longer to fill up.

Sir D. Brandis notices the numerous rootlets that are formed at the base of the Palmyra trunk, these are formed, after the above-ground stem is formed, as can be ascertained by cutting open the leaf sheaths shortly after the trunk has started above ground, it may be that, just as in the seedlings as each leaf is formed so is a root formed coming down the central axis and thrusting outwards the rootlets formed before it, so in the maturer plant as the leaves are developed at the top of the stem new rootlets are formed in the centre and thrust out the older ones which find an exit near the base of the stem. Some palms produce rootlets at the nodes, *e.g.*, (*Areca*), as do also bamboos, sugarcane, and some other grasses; the formation may, perhaps, be on the same principle as the Palmyra, but the subject requires a special study, as it would be interesting to know why the nodes form a specially good outlet for the pushed-aside roots.

WALTAIR: A. W. LUSHINGTON.
December 1908.

In continuation of my note on palms, I have been through a bamboo forest since that article was written and was able to note the following facts —

(1) The reason why rootlets came out at the nodes is evidently because the part is kept more tender than any other portion of the internode by the sheath, for the development is not exactly *at* the node which is the point of insertion of the sheath, but just above it, and this supra-nodal portion is always whiter and more tender than the rest of the inter-node, when the sheath is pulled off it.

(2) In a very large number of cases, (but by no means invariably), the fringe of nodal rootlets is longer on the side opposite the point whence a branch comes off at the node, and similarly the nodal root fringe is often longer on the inside of a clump of bamboos than on the

outside where branches are more developed owing to their being more in the light.

(3) When the nodal fringe of rootlets begins to form, it usually does so by means of small tubercles on the side opposite the point whence a branch comes off from a node, and similarly on the inside of a clump of bamboos.

(4) I took a piece of bamboo when the bud of a branchlet was beginning to develop, and cut a section of about ⅛ to ¼ inch thick horizontally across it, just so as to contain the whole node and a fragment of the tissue above and below it, and examined it under the microscope (power, × 8); above, the fibrovascular bundles of the branchlet were plainly distinguishable from the rest of the tissue by the colour and size; below, there was no such trace of these fibrovascular bundles; they seemed to be stopped by the node in their downward course down the stem and to proceed horizontally, and to tend to come out at the point opposite the branchlet bud above the node

WALTAIR: A. W. L.
3rd January 1909.

LIGHT BURNING AND NATURAL REPRODUCTION OF SAL.

By light burning is meant burning in the early part of the fire season when the grass, undergrowth and debris are not dry enough to burn fiercely. By such a process these impediments to the germination of sal seed are burnt down to ground level. Light burning does not of course obviate the necessity of the cutting out of miscellaneous species of soft wooded trees which are often found suppressing advance growth of young sal saplings and poles, for were the fire fierce enough to do this, it would at the same time burn back the young sal, the improvement of which is the very object being sought after.

The advantages of light burning are :—(*a*) that the ground is cleared beforehand for the reception of the sal seed, for the greater part, if not all, of the rank growth of shrubs and grass is burnt. Vegetable debris is also consumed and the resulting ash manure makes the soil lighter in consistency ; (*b*) that the operation is undoubtedly less expensive than the other operations in vogue for the reproduction of sal forests

But though in a good seed year, the process is expected to result in good natural regeneration of sal in an inexpensive way, it must be borne in mind that with the germination of the seed, the rank weeds and grass will spring up again, more vigorously too, if possible, on account perhaps of the stimulus of the ash manure. Then the difficulty arises as to how to prevent the young sal seedlings being suppressed by this rank re-growth. Two courses are possible :—(1) to have recourse to protection from fire, or (2) to burn over the area again at the commencement of the next fire season, if the young seedlings have survived the drippings during the rains from the cover overhead.

In having recourse to (2) the question arises as to whether the root systems of the seedlings less than a year old are sufficiently strong to throw up coppice shoots. From observation the writer fears that they are not. If they were, there would not be such a want of reproduction in unprotected areas.

It therefore appears that although light burning, if done judiciously, may assist in the germination of sal, protection from fire is necessary for their preservation thereafter, at least for some years until the root system of the seedlings are sufficiently developed to be able to send up shoots after being burnt back.

Another drawback of light burning is that in practice, all parts of a given area vary as to the condition of young sal growth. Accordingly all parts will not be benefited, and indeed many parts will always be retarded by the process. Thus where young sal does exist it would have to be burnt back in order to benefit the parts where none is found. The soil, too, is undoubtedly impoverished by continued fires which destroy the organic manures, and though an occasional fire may improve the consistency of the soil, the

preservation of the decaying vegetable matter and humus is most urgent in order to improve the quality of the soil and render it in a fit state for a seed-bed

BARAJHAR RANGE: SUKH LAL DUTT,
Buxa, E. B. and Assam. *Forest Ranger.*

[In sowings of sal in grass plains we have observed that young sal plants which were burnt back at the age of nine months, had vitality enough to send up coppice shoots, but this would of course depend on the condition of the soil, the degree of moisture therein, and more particularly on the season.

We are, however, of opinion that strict protection from fire is the best course. As far as the soil is concerned it seems certain that protection from fire is beneficial, both as regards fertility and degree of moisture. It would appear that where reproduction is still wanting in areas which are protected from fire, it is because the areas have not been protected for a sufficient length of time. Recently we saw an area of sal forest which had been protected from fire for nearly 30 years in which natural reproduction has established itself only during the past 3 years. If the area had been inspected 4 years ago it would have appeared that protection from fire for some 26 years had been a failure as far as regeneration was concerned. After an area has been subject to fires for a great number of years, the soil often gets into a very bad state and it may take many years of protection to bring it into a suitable condition for a seed bed for the principal species. In the meanwhile some indication of gradual improvement is generally observable. Grass gradually gives place to shrubs and the latter to soft wooded miscellaneous species and ultimately reproduction of the principal species appears. It may take a great number of years of protection to improve surface soils, exhausted by repeated fires, sufficiently for sal reproduction to become established.—HON. ED.]

REVIEWS AND TRANSLATIONS.

SCHLICH'S MANUAL OF FORESTRY, VOLUME V, FOREST UTILIZATION.*

BY W. R FISHER, 2ND EDITION.

[Contributed.]

It is now over twelve years since the first edition of Mr. W. R. Fisher's translation of Gayer's Forstbenutzung appeared in the form of Vol. V of Schlich's Manual of Forestry. The present edition is a translation of the ninth edition (1902) of Gayer's work, which was brought out in collaboration with his successor and former pupil, Dr Heinrich Mayr Gayer, whose health had been far from good for some time, although his mental faculties remained unimpaired, died on the 1st of March 1907, at the advanced age of 84, honoured and lamented by his many pupils and friends throughout the world.

The question is sometimes asked why Mr. Fisher has not produced an original work on Forest Utilization, suitable for English, and to some extent for Indian and Colonial requirements His answer to this is given in the preface to the present edition namely, that such an original work could be produced only by borrowing largely from Gayer's classic work and by following closely on the lines laid down by him. As a compromise Mr. Fisher has inserted numerous translation notes in brackets throughout the book, in which British, Indian and other usages are exemplified. This procedure, as Mr. Fisner states, is certainly the most honest course to pursue, even if it renders the text at times somewhat disjointed.

The volume runs to 840 pages as compared with 779 pages in the first edition, and is copiously illustrated with 402 illustrations in the text, 5 full plates, and a frontispiece portrait of the late Dr. Gayer. The book commences with a discussion of the various

*Schlich's Manual of Forestry, Vol. V, Forest Utilization, by W. R. Fisher, M.A., 2nd edition 1908. London, Bradbury, Agnew and Co., Ld., 10, Bouverie Street.

technical properties of wood which are treated of a good deal more fully than in the first edition. The subsequent arrangement of the subject-matter has been somewhat altered in this edition, the Chapter dealing with the industrial uses of wood finding a place at the end of Part I (harvesting, conversion and disposal of wood), instead of being placed near the beginning of it as in the first edition. This re-arrangement is perhaps of little practical importance, though there was certainly one advantage in the former arrangement in that the student after having studied the various properties of wood was immediately taken on to their connection with the various uses to which wood is put. The portions dealing with minor produce have also been re-cast and considerably altered.

We congratulate Mr Fisher on the results of his work, for the new edition of his "Forest Utilization" contains a large amount of useful matter, and will be a valuable addition to works of reference on the subject.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE SPEAR AS A SPORTING WEAPON.

Although the heading of this article would rather sound like an essay on a prehistoric weapon, it is wonderful what a variety of game is still accounted for every year by the spear in India. From time immemorial the lance or spear has been one of the favourite weapons of the East, and no better spear heads in the world can be yet found than those forged by Bodraj, of Aurungabad, and Arnachellum, of Salem. In fact, among pig-stickers a head made by either of the above spearmakers has just as big a reputation as a Holland and Holland rifle or a Purdey gun among shooters. There are various shapes of head, each of which has its own advocates, *viz*, the bayleaf, diamond, and bayonet. For myself I prefer the bayleaf, because, as its name indicates, it is shaped like a leaf, is easy to withdraw, and having a broad blade, makes a very severe wound, and can be driven home at almost any angle. The diamond shape if driven between the ribs (of a pig, for instance) is very liable to stick owing to the sharp corners of the blade, and also has the disadvantage of having to be held rather more upright than other shapes, otherwise it will not penetrate, owing to the corners instead of the point striking first. The bayonet shape is very well in its way, but to my mind does not cause sufficient shock, as the wound it makes is very small and causes little bleeding. And now as to shafts ; these differ in length and weight at the butt. The long, or Bombay, spear is 8 ft. in length, with a small amount of lead at the butt. The Bengal spear is from 5½ ft. to 6 ft. in length, with a very heavy lead base, often as much as 6 lbs. Which is the better of the two is a very vexed question, but one may safely say that on the Bombay side, where the going is open, the long spear is the best, and that in Bengal, where the going is often through long grass and crops,

the long spear would be quite useless, as it would be knocked out of the hand, and the short, "jobbing" spear is the only alternative. So much for the weapon itself, which will always remain very much as it is. No improvements, as in other weapons, can be made, and our spears of to-day are the same as our grandfathers used before the Mutiny.

The most usual object of the chase is, of course, the wild boar, but it would be hard to mention any class of animal that has not been stuck at one time or another. I have always been brought up to believe that there are only one or two instances of a tiger having been speared, but one at least of these is authentic, and I believe I am right in saying that Sir James Outram was the lucky man. A panther being speared, although not a matter of every-day occurrence, is still common enough, and a year rarely passes without one or more instances of panthers being put up while beating for pig, and being fairly speared and killed in the open; in fact, I have done it myself. If the first spear delivered is a really heavy one, and goes through the lungs or other vital organ, there is usually little difficulty in polishing the beast off; but if, as is sometimes the case, a slight wound is caused by a novice at the game, or the spear merely pierces the loose skin (very like that of a cat) and then turns, trouble may be looked for.

This occurred about two years ago in the Meerut Tent Club, the result being that two or three officers of the 17th Lancers and Artillery were severely mauled. The only time I have ever killed a panther with a spear, we put him out of some high elephant grass while pig-sticking in the Terai; he got away with about 20 yards start from three of us bounding among the grass, which was about 6 ft. high like a great yellow indiarubber ball. My pony was not as fast as the two others, and after galloping about 200 yards they had some ten lengths' lead of me. I saw them stop, as the panther had crouched like a rabbit, and they overshot him. As I came up I caught sight of him flat along the ground, head on to me. I rode straight at him, as if I was tent-pegging and as I lowered my spear he jumped. The spear caught him just behind the near shoulder, and went straight through him up to my hand,

the blood spurting out all over my forearm. The beast's left paw tore my breeches, and his right paw knocked away the pony's fore-legs, bringing us down in a heap. I remember my sensations rather vividly, as I could hear the beast grunting quite close to me, and expected to be mauled every second. I buried my face in a tussock of grass, and, putting my hands over the nape of my neck, awaited developments.

I soon heard one of the party shouting out asking if I was hurt, but I was not answering any questions, and soon after the line of elephants was brought up. The next thing I remember was finding myself on the pad of a live elephant, and quite safe and sound, but how I got there was a mystery. I was told afterwards that my agility was something wonderful We brought the line forward, and were promptly charged in a half-hearted way, as the poor beast was impaled on the spear, and looked like a large yellow caterpillar with a pin stuck through him. We threw stones at him, and kept him on the move until he died, about twenty minutes later. My pony had galloped off to camp in the meantime, and when I got there I found him none the worse for his adventure, with the exception of a few scratches on the chest.

After sticking a panther or pig a hyæna is poor sport; he stumbles along over the ground at a great pace, and often gives as good a run as a pig; but he is a coward, and dies like one. His skin is not worth having, and if there is a chance at any more legitimate game it is not worth while tiring one's mount, and often better to let him go in peace.

A bear, I believe, affords great sport, but very few horses can be found to go up to him. In the old days bear-spearing from horseback was quite a common performance, but how it was done, and where, has always been a marvel to me, as bear country is usually quite unrideable. The bear when attacked always gets up on his hind legs, and has a playful habit, I am told, of striking at the horse's head and getting caught up in the bridle, which is apt to cause trouble. There are several cases of bison, and also buffalo, having been speared, but not for many years past, which, I fancy, is accounted for by the fact that they have diminished

greatly since then, and are nowadays strictly preserved and it is very difficult to obtain permission to shoot them.

Deer, such as swamp deer, sambhur, and cheetal, can be easily speared if found in rideable country, but as a rule they are near the edge of a forest, where trees make riding after them impossible. I have once had a good run after a swamp deer, which had gone down to water, and was about a mile from the nearest jungle. He took me at a rattling pace for the first half mile, and then jumped, and I managed to spear before he had gone more than 300 yards on the new track.

Nilghai, or blue bull, afford a really good sporting run, as, like a pig, *they seem always to select the worst going possible.* They are said, also, to charge when speared, but I have never seen them do this. I have only heard of one black buck, or Indian antelope, being speared when unwounded. This was done near Bareilly about three years ago by a young gunner subaltern, who rode after a buck bareback and speared him, after going several miles. This I believe to be an unequalled feat of horsemanship.

The para, or Indian hog deer, gives a run of about a mile and a half at racing speed, but after that lies down in a bush, and can be picked up. To show what a variety of animals may fall to the spear in rough jungle country, I may take our bag in the Terai as an example. It consisted of four pigs, one panther, one hyæna, one black buck, and three hog deer. I have grave doubts about an elephant or rhinoceros ever having succumbed.— *By R. C. G. in the Field.*)

THE DEGENERATION OF TIGERS.

The November number of the *Indian Forester* contains an article by Mr. Dunbar-Brander on the above subject. Mr. Brander gives the length and weight of six tigresses and a tiger, shot in the Hoshangabad district in 1908, from which, comparing them with the measurements of previous years, he deduces that the tigers in the district have degenerated in size. At the same time, in pointing out this so-called degeneration, he ascribes it to the older

tigers having been killed off in outlying districts, and their place being taken by younger animals which have not reached full maturity, and are presumably lighter, for the general tendency of tigers, like human beings, is to put on weight with age.

I do not find Mr. Dunbar-Brander's figures or deductions in any way convincing. In the first place the term "degeneration," which should indicate deterioration of the race, is surely misleading. It is, in fact, a misnomer for even if the writer proves that smaller and lighter tigers are shot in the Hoshangabad district than in days gone by, he ascribes the fact to reasons to which the terms cannot be applied The average length of the six adult "degenerates" is given as 8 feet 1½ inches, and the weight 265lbs. The average length of similar animals seven years ago is said to have been 8 feet 5 inches, and the weight 298lbs. Now the statistics of a large number of adult tigresses shot in districts where any causes of deterioration were certainly not in operation shows their average length to have been 8 feet 2 inches. In length therefore, the "degenerates" do not show up badly. I much regret not having weighed all these tigresses. One of fair size turned the scale at 260lbs. It is unfortunate that Mr. Dunbar-Brander does not give the length of tail of all the animals in his list. The only tigress of which this measurement is given was 8 feet 2 inches in length, including 2 feet 4 inches of tail. This is a remarkably short tail, that appendage being ordinarily about 3 feet long. This "degenerate" with a 5 feet 10 inch body was, therefore, a very large animal The longest tigress I have shot had a body only 5 feet 8 inches in length. The average is 5 or 6 inches shorter.

Turning from tigresses to tigers, the author of the article in the *Indian Forester* gives in his list of "degenerates" only one male, length 8 feet 11 inches, including 2 feet 9 inches tail, and weight 386lbs.! Surely statistics based on one specimen are worthless! And to speak of "marked degeneration," and say "we have got down from 9 feet 2 inches and 419lbs. to 8 feet 11 inches and 383lbs" quoting for comparative purposes this solitary animal and the average of seven years ago is unconvincing. Moreover, this tiger is by no means a small one, it also has a short tail Taking the

head and body measurements of nineteen tigers, I get an average of 6 feet 2½ inches; a very fine one weighed 400lbs. The "degenerate" would not, therefore have been a small one on my list. Methods of measurement differ, and probably measurements are now made more carefully than in the days of ten-footers (I have never seen one over 9 feet 8 inches, measured in a straight line), and of the specimens recorded, in an old edition of Chambers' Encyclopædia, where it is said, "the tiger is sometimes fifteen feet in entire length to the tip of the tail, an instance is on record of eighteen feet." But even if these were giants in those days, I do not believe tigers have degenerated in our time. Perhaps our tape measurements are not so elastic.—(*By R. G. B. in the Pioneer.*)

EXTRACTS FROM OFFICIAL PAPERS.

NOTE ON THE POWELL WOOD PROCESS FOR PRESERVING TIMBER.

GENERAL.

This process, as is now well known, consists in impregnating wood with an antiseptic saccharine substance in order to render it immune from rot and the attacks of white-ants and other insects. At the same time it is claimed that the wood is hardened and completely seasoned, and warping and splitting are prevented. Many woods are unchanged in appearance by the treatment, but some, notably *salai* (*Boswellia serrata*), are rendered more handsome in grain. In India at the present time the beautifying of wood, however, is of minor importance, the chief desideratum being to obtain a thoroughly satisfactory and cheap method of rendering so-called "inferior" woods proof against rot and insects, so that the outturn of sleepers and building timber may be increased.

EXPERIMENTS RECORDED.

2. It is unnecessary to enumerate the various authenticated tests which have been carried out with powellised wood in the tropics ; these are to be found in hand-books issued by the Company

and obtainable from their Agents Messrs. Killick, Nixon & Co., Bombay.

The writer has at present some powellised deal under observation. It has been down in a spot infested with white ants since 4th March 1907, and has up to date (17th December 1908) not been touched.

A piece of untreated deal was nailed to the powellised piece when first put down, and was totally destroyed by white-ants in a few weeks. Another untreated piece was recently placed with the powellised piece and is being rapidly destroyed.

Similar tests in other parts of India confirm these results. A large number of powellised and untreated pieces of different Indian woods are now being laid down, but it will be some time before any results can be arrived at. Sleepers of various kinds of woods are also being tested on the railway in Burma. Messrs. Mackenzie & Co., Bombay, in 1906 carried out tests on powellised wood to ascertain if it looses its antiseptic properties, if exposed to the weather. Planks of poon and mango were subjected for four nights and days to steam forced on them by an exhaust pipe, then a stream of water was directed on them for four days, and then the wood was subjected to alternate rain and sunshine in the monsoon, and was finally cut up and placed in white-ants' nests in three different places, along with untreated wood of the same species. The untreated pieces were quickly destroyed, while the powellised pieces remained untouched.

It has, of course, not yet been proved that the process will stand the test of time in India, and that sleepers will remain immune from destruction for many years. The tests which have been carried out, however, show that powellised wood effectively resists white-ants for the periods to which the tests have extended hitherto.

POWELLISING PLANT.

3. Powellising plant on an experimental scale has been working at Bombay for some time past. An installation, capable of treating 150 tons of wood per week, is approaching completion at

Bombay, and will be capable of undertaking the impregnation of wood on a larger scale.

The value of the process has been recognised in Australia, where the Western Australian Government has recently erected large works. Other extensive works have been completed, or are approaching completion, in Sydney, New Zealand and Tasmania. America and Germany have also arranged to erect works, and other countries are negotiating.

TERMS FOR ERECTING POWELLISING INSTALLATIONS, AND COST THEREOF

4 So far as the results of tests show, there would appear to be great scope for extending powellising installations throughout India and Burma. This the Powell Wood Process Co., Ld., are anxious to do if they get reasonable support from Government and from the various railways

The terms and cost of erecting and working such installations will be supplied in strict confidence to *bonâ fide* enquirers personally or officially known to the undersigned.

R. S. TROUP.

Photo-Mech. Dept., Thomason College, Roorkee

Photo. by Barrington Moore.

Kahriabunda Forest, Jalpaiguri Division.

Showing excellent reproduction of Sal in a forest continually burned, and then protected for a year.

VOLUME XXXV NUMBER 4

INDIAN FORESTER

APRIL, 1909.

THE NEED FOR AN AFFORESTATION BRANCH OF THE FOREST DEPARTMENT.

In the March issue we reproduced on page 176 an article from *Indian Engineering* drawing attention to the want of attention paid in this country to both deforestation and afforestation, which are rightly described as lying at the very heart of successful forest conservation. There is no getting away from the fact that vast areas all over India have been denuded of forest during the past half century, and the cause of this denudation is to a great extent due to the continued progress of agricultural and industrial pursuits under the "Pax Britannica." At the same time very little afforestation work has been done. We have repeatedly drawn attention to the urgency of afforesting waste lands in order to promote the well-being of agriculture which is the most important industry in the Empire. We have pointed out time after time the advantageous results which would be attained by such afforestation, such as increase of rainfall, regulation of water-supply, prevention of floods and erosion, moderation of climate, improvement of irrigation,

provision of a plentiful supply of fuel, fodder and timber for agricultural purposes, saving of manure for the crops and ultimate prevention of famine. Even in conservative England, the question of afforestation has lately received a great deal of attention, and in this issue we are publishing the recommendations of the Royal Commission which has recently been enquiring into the subject. And yet in India where we already have a professional department no steps have been taken to plan and carry out a suitable scheme.

It may well be that many will hold that the Forest Department in this country has not fulfilled its duty in these respects, and certainly there is much to be said for their view. We must point out however that the Department has with difficulty obtained the present scale of staff which is still markedly inadequate for the proper management of the lands already reserved as forests. Every step of progress in forestry has been an uphill fight, and with the opposition that it has met with at every point it is surprising that so much has been attained. Fifty years ago all the lands which are now under the Forest Department were waste lands under the management of District Officers, and it is a strange fact that in some provinces there are still thousands of square miles of waste lands, the property of Government, which are not yet under the control of the Department. So far then from adopting a regular scheme for checking deforestation and for pushing on afforestation, the Forest Department has not yet been allowed to manage all the existing forest lands, and the first step, we consider, should be that all waste lands owned by Government should be made over to the management of the Department. If it were desirable in any case it could be laid down that the areas were not to be managed for a profit, and that when necessary land should be given up for the extension of cultivation, but while the lands are waste, often with a good deal of forest already existing on them, we strongly urge their being handed over for management to the Department specially trained for the purpose.

We have already stated that the Forest Department as constituted at present has more than enough to do in the management of existing forests and such matters as deforestation and

afforestation on lands outside the reserved forests are beyond its scope, for it would not be possible for the existing staff to do these works in addition to their present duties. The subjects however appeal strongly to every keen Forest Officer, and we strongly advise the expansion of the Department in order to deal with them.

Before going further, it is necessary to state that the work of afforestation is a very different branch of forestry to that of management of existing forests. Forest Officers in India have had little experience as yet in afforestation on a large scale, and though trained in the subject under conditions existing in a temperate climate, they will encounter much greater difficulties in this country on account of the extremes prevailing at different seasons of the year. They will have many problems to solve in India as to the cheapest, quickest and most successful methods of creating forests on waste lands. The choice of species to suit various soils and the methods necessary for successfully propagating the individual species are matters which can only be learned by experience. Unfortunately, in the past, plantations have been as a rule discouraged and artificial reproductive works have been often condemned as waste of money. This attitude we believe arose, first, from the fact that we have not sufficient staff to manage our existing forests properly, and secondly, because we are still in the experimental stage as regards plantations, so that it often happens that money spent on them is not productive. Experience in this case, as usual, must be bought, and if we set to work systematically, it will soon be found out how to afforest various types of soils quickly and cheaply.

We are emphatically of opinion that a separate Afforestation Branch of the Forest Department is needed. We by no means wish to advocate that the Government should commit itself immediately to a vast scheme of reboisement, and as a beginning we think it would be sufficient if one Imperial Officer were specially appointed for this work with an Extra Assistant Conservator or good Ranger under him in each Province. It is probable that all Provincial Governments would be able to put small areas of different classes of waste land at his disposal, and it would be his duty

to direct experiments to find out how each class can best be afforested.

By the time it has been discovered how to successfully afforest the various classes of soils, Government will, we trust, be able to adopt a regular scheme for the gradual afforestation of waste lands, with a fair prospect of success, and then the Afforestation Branch could be gradually expanded in order to cope with the work.

In the meanwhile the special Afforestation Officer, in addition to directing such experiments, could inspect and tabulate the waste lands suitable for afforestation, so that by the time that Government is prepared to proceed with a reguler scheme, there would be useful data ready as to the position, quantity, and kind of land available. He could also make enquiries and work out the best methods of obtaining the land. We do not for a moment suppose that Government would acquire all the land. It would be often possible to arrange with owners that Government should afforest the areas and hand over all profits to the owners of the land. Similarly when village lands are taken up all profits might be divided among the community concerned. In other cases it might be possible to close areas for afforestation and in return grant a proportion of the profits and so on

We must, however, point out that in order to ensure the success of any general scheme of afforestation, it is absolutely necessary to have the people with us, and to gain this end we recommend that a simple primer be prepared for use in all schools throughout the country, setting forth the advantages of forests to agriculture from all points of view.

The Afforestation Branch might also be required to carefully watch the extension of deforestation on areas outside the reserved forests, to report on all cases in which the denudation of the land would have disastrous effects, and to submit proposals as to the action which ought to be taken to prevent it.

At first all this would be done in a small way, but we believe that once an Afforestation Branch is started, it will gradually expand and become of more importance if possible to the country in general than the present Forest Department. The latter would

gradually expand also, for as areas became successfully stocked and felling became necessary or possible, they would of course be handed over for management to the branch of the Department now in existence.

We believe that in the adoption of this policy is the one key to the prevention of famines, and the progress of such an Afforestation Branch would be watched with intense interest by all the world.

SCIENTIFIC PAPERS.

STATE AFFORESTATION IN THE UNITED KINGDOM.

RECOMMENDATIONS OF THE ROYAL COMMISSION.

The second report, dealing with the subject of afforestation, of the Royal Commission on Coast Erosion, the Reclamation of Tidal Lands, and Afforestation, has been issued as a Blue-book [Cd. 4460]. The members of the Commission are—Mr. Ivor C. Guest, M.P. (Chairman) Sir W. H. Browne ffolkes, Sir Leonard Lyell, Sir William Matthews, K.C.M.G., Mr. E. Stafford Howard, C.B., Mr. H. C. Monro, C.B., Mr. W. Phipson Beale, K.C., M.P., Commander G. C. Frederick, R.N., Mr. John Galvin, Mr. H. Rider Haggard, Dr. T. J. Jehu, Mr. A. Levy Lever, M.P., Mr. R. Beattie Nicholson, Mr. Patrick O'Brien, M.P., Professor W. Somerville, Mr. Fraser Story, F.R.S.E., Mr. T. Summerbell, M.P., Mr. John Ward, M.P., and Mr. A. Stanley Wilson, M.P. The original terms of reference to the Commission which was appointed in July 1906 were to inquire and report—

(*a*) As to the encroachment of the sea on various parts of the coast of the United Kingdom and the damage which has been or is likely to be caused thereby; and what measures are desirable for the prevention of such damage; (*b*) Whether any further powers should be conferred upon local authorities and owners of property with a view to the adoption of effective and systematic schemes for the protection of the coast and the banks of tidal rivers; (*c*) Whether any alteration of the law is desirable as regards the management and control of the foreshore; (*d*) Whether further facilities should be given for the reclamation of tidal lands.

Under a later warrant, dated March 1908, the following reference was added :—

(*e*) Whether, in connection with reclaimed lands or otherwise, it is desirable to make an experiment in afforestation as a means of increasing employment during periods of depression in the labour market, and if so by what authority and under what conditions such experiment should be conducted.

The first report of the Commission was published on August 1st, 1907, before the issue of the second warrant. Since March 31st the Commission have held 50 sittings, and have heard 80 witnesses, chiefly on the question of afforestation. The following is a synopsis of the principal conclusions reached in the present report :

1. *Afforestation is practicable and desirable.*

2. Approximate available area in the United Kingdom without material encroachment upon agricultural land is 9,000,000 acres.

3. Best rotation to secure sustained timber yield requires 150,000 acres to be afforested annually.

4. Employment : (*a*) Temporary.—Temporary employment is afforded annually to *18,000 men during the winter months.* Further, an almost equal number would indirectly derive employment in the incidental and subsidiary occupations connected with forestry. This figure might be increased in any year to meet exceptional pressure of unemployment. (*b*) Permanent.—Permanent employment is afforded to one man per 100 acres afforested, rising to 90,000 men when the whole area has been dealt with. (*c*) Ultimate.—The employment connected with subsidiary industries, *i.e.*, conversion and manipulation, etc., of the timber crop, would afford occupation for a still larger population.

5. Any scheme of national afforestation should be on an economic basis.

6. Labour.—There are sufficient unemployed persons willing to submit to, and able to satisfy, ordinary labour tests, who could advantageously be employed without a period of special training.

7. Finance. Afforestation represents a productive investment, and should be financed by a loan. The annual sum required for the full scheme is £2,000,000. The interest on the loan should be defrayed out of taxation. The net deficit will be £90,000 in the first year, and will rise progressively to £3,131,250 in the fortieth year, after which period the forest becomes more than self-supporting

8. Profits.—After 80 years the net revenue from the forest, at present prices which promise to be materially enhanced should be 17½ millions. This represents 3¾ per cent on the net cost calculated at accumulated compound interest of 3 per cent. Looked at from another point of view, the State will then be in possession of property worth £562,000,000, or about £107,000,000 in excess of the total cost involved in its creation, calculated at 3 per cent compound interest.

9. Administration and control.—The afforestation scheme to be entrusted to a special Board of Commissioners. In default of purchase by agreement, and to be acquired if necessary under compulsory powers

10. Disturbance.—The acquisition of grazing areas for sylviculture might necessitate a modification of the existing agricultural system on certain farms. There is no reason to suppose that the remaining lowland areas on such farms could not either be adapted to other forms of agriculture or could not, in many cases, be profitably utilised for small holdings. The acquisition of grazing areas, private or common, should present no difficulty which cannot be satisfied by arbitration and reasonable compensation.

11. Incidental. Afforestation creates a new industry, it does not compete with private enterprise. The conversion of comparatively unprofitable lands into forests enhances the productiveness of the adjacent areas and should promote the development of the small holdings movement. More than any other apparent remedy, afforestation will stem the tide of rural depopulation.

THE POSSIBILITIES OF AFFORESTATION.

The report is divided into five main sections, dealing respectively with the present position of British woodlands, the question of unemployed labour in its relation to afforestation, the nature and extent of land suitable for afforestation, the administration of a system of afforestation, and the finance of the subject.

The present condition of British forestry is considered at length, and the Commissioners sum up their conclusions on this branch of the subject with the statement that the comparative neglect and failure of sylviculture in the United Kingdom is not in any sense to be attributed to natural or inherent disadvantages of soil or climate, but that, on the contrary, the conditions which prevail are favourable to the production of high-class timber, if scientific methods of afforestation be pursued. Even at present prices, they think, sylviculture should prove a safe and remunerative investment; but when the highly probable advance in the price of timber is considered, it does not seem unduly optimistic to expect that enhanced profits will accrue.

Their inquiries upon unemployment in relation to afforestation convince the Commissioners that a national scheme of afforestation would contribute to the solution of the unemployed problem, and that the extent of this contribution would depend upon the scale of the undertaking. While the employment of a permanent staff in maintaining a forest area and the encouragement of

small holdings in connection with sylviculture would go far to stem the tide of rural depopulation, it is in the creation of a forest that the largest demand for the supply of labour would be made.

The planting season, the period of greatest activity in sylviculture, coincides with the season of acutest annual unemployment and, moreover, the elasticity to which sylviculture is susceptible renders it capable of considerable adjustment to meet recurrent or abnormal times of depression. With careful selection, proper supervision, and due regard to previous occupation, afforestation, mainly through the agency of the unemployed, should not prove unsatisfactory either as regards the work performed or its financial results, while the advantageous effect on the men themselves cannot easily be over-estimated.

As to the nature and extent of land suitable, the Commissioners find that, of the 2,826,602 acres of 'mountain and heath' land which may be assumed to lie below 1,500 ft in England and Wales, it would appear to be reasonable to assume that 1,500,000 acres are afforestable. To this another 1,000,000 acres might be added as representing poor tillage land that would pay better under forests than as farming land. Thus there is, including 6,000,000 acres in Scotland, an aggregate of 8,500,000 acres of afforestable land in Great Britain, to which may be added at least 500,000 acres in Ireland, making 9,000,000 acres in all.

A STATE SYSTEM ADVOCATED.

A consideration of the question of administration leads the Commissioners to the conclusion that land should be vigorously taken in hand under a large scheme of national afforestation. They consider it "in the highest degree in the public interest that a beginning should forthwith be made with a comprehensive scheme of national afforestation," and suggest that the State should be empowered to acquire suitable land by compulsion, and that a general survey should be made to ascertain what lands are available for the purpose. At the same time they are of opinion that the co-operation of landowners should not be excluded from consideration. The national scheme should be

administered by Commissioners specially appointed for the purpose and the total area should be divided into districts.

Upon the important question of finance the Commissioners emphasise the desirability of financing afforestation by loan. Taking the land that may be afforested as 9,000,000 acres, they calculate that, if 150,000 acres are annually afforested for 60 years, one-third of the area being worked on a 40 years' rotation, and two thirds on an 80 years' rotation, the annual deficit on the transaction rises

from £90,000 in the first to £3,131,250 in the fortieth year; in the forty-first and up to the sixtieth year the forest becomes practically self-supporting; in the sixty-first year, and subsequently, an increased revenue is received, but it is not until the eighty-first year that the full results are obtained; in this year and subsequently an approximate and equalized revenue of £17,411,000 per annum being realized. Further calculations show that the value of the property would then be £56[illegible],075,000, or £106,993,000 over and above the cost of its creation. The equalised annual revenue of £17,411,000 represents a yield of £3 16s. 6d. (approximately) per cent. on the excess of accumulated charges over receipts.

If, on the other hand, the afforestation of 6,000,000 acres were proceeded with steadily throughout the rotation of 80 years at the rate of 75,000 acres annually,

the annual deficit on the transaction rises from £45,000 in the first to £1,565,625 in the fortieth year; in the forty-first year and up to the seventieth year the forest becomes practically self-supporting; in the seventy-first year and subsequently an increased revenue is received, *but it is not until the eighty-first year that the full results are* obtained, a revenue in that year, and each subsequent year of £9,912,500 being realised. Further calculations show that the value of the property would be £320,000,000, or £60,944,000 over and above the cost of its creation. The revenue of £9,912,500 represents a yield of £3 [illegible]6s. 6d. (approximately) per cent on the excess of accumulated charges over receipts.

AFFORESTATION A "SOUND INVESTMENT."

At the end of their report the Commissioners summarise their conclusions as follows:—

(1) The natural conditions of soil and climate in the United Kingdom are favourable *to the production of high-class commercial timber such as is annually imported into* the country in very great quantities.

(2) The afforestation of suitable lands in the United Kingdom, if undertaken on an adequate scale and in accordance with well-recognised scientific principles, should prove at present prices a sound and remunerative investment.

(3) In estimating the profits of sylviculture account must, moreover, be taken of two facts—the increasing consumption of timber per head of population all over the world, in spite of the introduction of alternative materials; and, further, the exploitation, waste, and destruction by fire of the virgin forests, especially those yielding the more important building timbers. Already a noticeable shortage of timber supply has resulted, as is evidenced by steadily rising prices and depreciating qualities in all markets. It seems impossible to escape from the conclusion that this tendency will be continued and accentuated, and that a steady and a very considerable rise in prices may be looked for throughout the present century. The security which afforestation offers for investment is therefore likely to be an improving one, with a corresponding increase in profits, but, to avoid all that is speculative, this prospect has been disregarded in framing our estimates.

THE AREA OF LAND AVAILABLE.

(4) The amount of land suitable for afforestation, but not now under timber, in the United Kingdom may roughly be put at a *maximum* of 9,000,000 acres. In determining this figure two considerations have been taken into account besides elevation and physical suitability of soil. The first is that the value of the land is not in excess of a sum on which a fair return may be anticipated on the expenditure. This will naturally vary according to the productive capacity of the soil and the crop which it will carry. The second consideration is that the land could not be more profitably utilised in any other way.

(5) A forest of 9,000,000 acres, in which are represented the various series of age-classes, may be expected to yield 9,000,000 loads annually in perpetuity. The importation of foreign timber from temperate climates into the United Kingdom in the year 1907 exceeded 8,500,000 loads, or approximately the annual supply which could be expected from the afforestation of the above-mentioned area.

(6) The withdrawal of 9,000,000 acres from its present uses would cause some gradual curtailment of food supplies and displacement of labour. Land suitable for afforestation is mostly devoted to the production of mutton. Calculations on the basis of the present consumption show that at most 60,000 tons, or 4·8 per cent. of the total home production of meat, or 2·6 per cent. of the present national consumption, would be ultimately displaced. As to labour, the employment furnished by the present uses, mostly sheep farming, to which the land in question is devoted, may be taken to average one man to 1,000 acres. This does not represent one-tenth of the permanent employment afforded by the maintenance of a similar area of land under forest.

(7) Systematic sylviculture aims at the production of a steady and continuous supply of marketable timber. To ensure the maintenance of these supplies the area should be divided for planting by the average number of years which the crop needs to mature; for example, if the life of the crop be taken as eighty years, the area to be afforested every year would, out of a total area of 9,000,000 acres, be 112,500 acres. But a more rapid system of planting may be adopted without seriously complicating the rotation, and, further, some adaptation to the temporary fluctuations of the labour market is feasible.

(8) The distribution of this 9,000,000 acres of suitable land is somewhat irregular. By far the largest areas are to be met with in the west and north of England, and throughout similar regions in Scotland. Ireland and Wales also contain a relatively large amount of this type of land. In the south and east of England, on the other hand, the areas in the aggregate are less extensive. Great diversity exists in the size of these areas, some counties offering large contiguous stretches, while in others the areas are characterised by their discontinuous nature.

ADMINISTRATION OF THE FOREST LANDS.

(9) The administration of national forest lands should be entrusted to special Commissioners.

(10) In dealing with these lands, subdivision into distinct districts, with an executive and administrative unit or centre commends itself from various points of view. Thus local employment would be afforded, local subsidiary industries would be encouraged, public recreation grounds would be provided, and, in connection with the establishment of such forests, small holdings would undoubtedly be multiplied.

(11) Sylviculture in the United Kingdom is an enterprise which rarely appeals to the private landowner or capitalist. The prolonged time for which capital must be locked up before any return can be expected, the loss of rent and burden of rates over the whole period, and the absence of security for continuous care and management, act as deterrents. None of these objections applies to the State, whose corporate life and resources lend themselves in an especial degree to an undertaking of this character. If the State plants, it will certainly reap, which the individual owner can rarely hope to do.

(12) If afforestation be promoted on a large scale the provision of suitable lands is the first step. For this purpose a general survey should be made, and the extent and distribution of such lands ascertained. As a rule it will be found expedient for the State to purchase from time to time such areas as are destined for planting, but some progress may conceivably be made along the lines of profit sharing, in which case the owner would forego the purchase price. Experience proves that, although much of the land required may be expected to be purchasable by voluntary treaty, yet compulsory powers would be necessary to facilitate transactions where voluntary treaty had broken down. The principles laid down in the Small Holdings Act of 1907 for the acquisition of lands should govern these proceedings, as to arbitration, restrictions, and safeguards. Where private owners can satisfy the Forest Commissioners that they are able and willing to afforest, under their supervision and to their satisfaction and give an undertaking to that effect, compulsory powers should not be enforced against such owners so long as that undertaking is fulfilled.

THE COST OF THE UNDERTAKING.

(13) The value of land falling within the definition of "suitability" may be taken, except in rare instances, to lie between £2 and £10 freehold value, but the average value of suitable lands, including the necessary buildings and other preliminary equipment, may be taken as £6 10s. per acre, and the average cost of afforestation also at £6

10s. per acre. If 150,000 acres be annually taken in hand, a sum of about £2,000,000 would be needed annually to finance the undertaking.

(14) *Money expended in afforestation differs in kind from other calls on the national purse.* It is a productive investment of capital. To provide this capital sum out of taxes would be an act of unprecedented generosity on the part of the present generation of taxpayers in favour of their posterity. No stronger justification for proceeding by loan than a reproductive outlay exists. The loan should be based on actuarial calculations showing initial cost, expenses of upkeep and management calculated at compound interest over the whole period, and the value of the property when fully matured. Such actuarial statements we have given, which show for the full scheme that after allowing 3 per cent. compound interest on all the capital invested, the approximate realized revenue would at the end of eighty years amount to £17,411,000 per annum, while the value of the property might be expected to be £562,075,000 or £106,993,000 in excess of the sum involved in its creation. A smaller scheme involving the afforestation of 6,000,000 acres (75,000 acres annually for eighty years) would show a profit of about £10,000,000 annually, or a capital value of £320,000,000, being £60,044,000 in excess of the cost of production.

(15) Coming to ways and means by which a loan of this character may best be provided, a point of great importance to be borne in mind is that, although the period of rotation of a timber crop may be taken as eighty years, yet after 40 years, owing to the value of thinnings, and the receipts of some short period crops, the forest becomes practically self supporting. Between the fortieth and eightieth years, the sales of timber will be sufficient to meet the annual charges, including the upkeep and the extension of the forests. After the eightieth year a large annual revenue will be derived. These considerations point to a free loan from the Treasury to the Forest Commissioners; the net deficit to be met would in the first year be £90,000 or £45,000, according to the extent of the operation, and would reach its *maximum* in the fortieth year, amounting in that year to £3,131,250, or £1,565,625. After this period the deficit would be insignificant, while in the eighty-first year the revenue derived would be £17,411,000 or £10,000,000 respectively, representing about 3¾ per cent. on the total accumulated costs of the undertaking.

SUPPLY OF "UNEMPLOYED" LABOUR.

(16) On the question of labour and its relations to forestry, the conclusions to which the evidence before them leads your Commissioners are that the operations involved in afforestation vary in the degree of requisite skill from little or none in rough road-making and surface draining to a considerable amount in the planting. Your Commissioners wish to make it clear that they have in contemplation a scheme of national afforestation on economic lines. They have no hesitation in asserting that there are in the United Kingdom at any time, and especially in winter, thousands of men out of work for longer or shorter periods, who are quite ready and able to perform the less skilled work without previous training, and with satisfactory results. There is a still larger class of unemployed who are capable of being trained to perform this or the higher class of labour, and such men can, if desired, be recruited through labour colonies distress

committees, labour bureaux, or charitable agencies. There is, then, no need to accept inefficient labour with the object of affording occupation to the unemployed. The labour employed in the national forests should not fall below the ordinary standards, and should be remunerated at the ordinary rate of the district for similar labour. Subject to the requisite standard of efficiency being attained, preference should be given to those temporarily or permanently unemployed in the district, especially where evidence of such efficiency can be furnished by public or private agencies for the reclamation and training of the unemployed class.

(17) To establish afforestation on commercial lines does not, however, preclude its being used as an instrument of social regeneration. A broad view of economics cannot exclude from its cognisance the grave national charge which unemployment with all its concomitant results involves, to say nothing of the personal deterioration by which it is often accompanied. Sylviculture is not unsuitable for building up the moral and physical fibre of even the most depressed of the unemployed classes, and its agency may well be invoked for this purpose, and advantage taken of its healthy and wholesome influences, provided that any additional expense incurred by the employment of less efficient labour be defrayed from a separate account.

(18) In estimating the amount of employment furnished by afforestation it is well to distinguish between the temporary labour involved in the creation of the forest and the permanent labour needed for its maintenance. Taking varying circumstances into consideration, it may be said that, on the average, it will take twelve men to afforest 100 acres in the planting season of four to five months, and that every 100 acres afforested will provide permanent employment for at least one man. If 150,000 acres be annually taken in hand, the labour of 18,000 men will be needed and permanent employment will in due course be afforded to 1,500 men, rising by an additional 1,500 every year until the end of the rotation. The number permanently employed would then approach 100,000. The labour absorbed by felling and converting timber, to say nothing of subsidiary industries which spring up around a timber supply, has been considered too remote to warrant detailed estimation, but there is undoubtedly a large field of employment in this connection. It is important to remember that, on the basis of £1,000,000 being annually spent on the operations of afforestation, apart from the cost of the land, employment would be afforded, directly and indirectly, to many more than 18,000 men. Indeed, the number employed may be roughly taken to be represented by about double that figure. For the incidental occupations, such as building, the making of implements, the provision of materials, etc., all involve the employment of additional labour.

(19) A special advantage of forestry in relation to labour is that it offers a new source of employment. The labour connected with timber and timber products imported into the country is performed abroad, and thousands of families are maintained on the produce of the labour associated with the timber industry. Another advantage bound up with the extension of sylviculture is that the market for its produce is so great that it is inconceivable that it could seriously interfere with the output from private woodlands, and no difficulty of competition between the State and individuals need be apprehended.

(20) The acquisition of grazing areas, private or common, for sylviculture might necessitate a modification of the existing agricultural system on certain farms. It is

unreasonable to suppose that the remaining low and areas on such farms could not, in many cases, either be adapted to other forms of agriculture or be profitably utilised for small holdings. Further, the conversion of comparatively unprofitable lands into forests enhances the productiveness of the adjacent areas, and should materially assist the small holdings movement. It has also the advantage of furnishing winter employment to small holders.

RECOMMENDATIONS OF THE COMMISSION.

In view of these conclusions the Commissioners recommend that—

1. Parliamentary powers be obtained to—

(a) Appoint Commissioners charged with the duty of carrying out a national scheme of afforestation.

(b) *Vest in them power to survey and determine what land falls under a statutory* definition of "suitability" and to acquire such land as from time to time may be required for afforestation or purposes incidental thereto.

(c) Equip the Commissioners with compulsory powers for the acquisition of such land on the precedent of the Small Holdings Act, 1907, so far as applicable, subject to the reservation of certain rights to private owners.

(d) *Authorise the Treasury to grant the Commissioners an annual free loan for the* necessary period.

2. (a) The Commissioners should prepare a general scheme of afforestation for the whole of the contemplated area extending over the entire period of rotation.

(b) An actuarial statement should be supplied by them to the Treasury indicating when and in what manner the loan and interest would be repaid.

(c) The afforestable area should be divided into convenient sub-districts.

(d) Work should be commenced in each, or as many as convenient, of the districts in such a way as to provide that the earlier operations, which may be regarded as experimental, should be capable of determination or of forming part of the complete forest scheme for each district.

Mr. A. Stanley Wilson, M.P., appends to his signature a reservation pointing out that, while he is in agreement with the findings of the Commission he is of opinion that certain passages in the report are too optimistic. He considers that in the financial estimates contained in the report insufficient allowance is made in connection with the cost involved in the utilisation of unemployed labour, and the risks which may be anticipated, if the forest areas of the United Kingdom be extended, from fires, pests, snowstorms, gales, etc.—(*The Times.*)

Dr. J. Nisbet contributes the following note, dated 21st January 1909, on the above subject. In the present financial position Government will most likely be unable to carry out the recommendations and in any case this great scheme would be certain to meet with strenuous opposition on the part of those highland land-owners—and they are many—who are desirous of planting if reasonable encouragement and assistance be given and who will strongly resent any attempt to expropriate such portions of their estates as might be scheduled as suitable for planting. All the British newspapers have commented on the scheme but as yet there has not been time to estimate the opinions of land-owners on the subject.

THE HYDERABAD FLOODS AND THEIR MORAL.

The recent terrible calamity which has visited the people of the great State of Hyderabad and has resulted in unprecedented distress and loss of life has been very fully commented upon both in the Indian Press and that of the world outside. All that is to be known upon the subject we have had put before us in the columns of the Press, and all parts of India have joined in the messages of sympathy which have reached H. H. the Nizam from all over the world.

In this article it will be sought to show how just such appalling calamities as have visited Hyderabad are possible elsewhere in India, if the advantages which science has placed in the hands of the administrator and ruler are treated with neglect. Some months ago a series of articles appeared in the columns of the *Pioneer* which sought to prove how important was the preservation of forests on the catchment areas of her great rivers. The articles endeavoured to show that the welfare of the people of a country is intimately bound up in and dependent upon the recognition of this truth. The principle was enunciated that only the State could safeguard the catchment areas of the rivers rising in the area under its rule, for private ownership, and the varying policy naturally implied by private ownership, was a very insufficient assurance that the head-waters of great rivers would be maintained in that

condition which is an absolute necessity if the levels of the waters of those rivers are to be maintained and if the silting up and drying up of the head-waters and devastating avalanches and floods are to be prevented.

That the evils and great dangers arising from denuding of the forest catchment area of a river have become fully recognised by the Government of India and outside the Government of India, the speeches of the Hon'ble Mr. J. O. Miller and of the Hon'ble Mr. Tika Sahib of Nabha in the Budget Debate in the Viceroy's Council of last March made apparent to all. That however these great dangers have not been fully appreciated by all the rulers and administrators of some of the largest of the Native States of the country the Hyderabad calamity has made all too apparent, and it may be that even so appalling a disaster as this one may not be without its silver lining if the reasons for its occurrence are thoroughly realised and assimilated.

In the accounts of the Hyderabad calamity the river Musi has played a leading part. This river rises in the Atraf Balda District and after a course of some 150 miles joins the Kistna river. The source of the river is in the hills 50 miles west of the city. It has been stated that on both sides the country all along this river's course has been flooded out and thousands of corpses were floated from this region down the Musi into the Kistna. Also that "the floods do not appear to have touched those places far removed from the rivers although the rain was general all over the dominions."

This Musi is a most insignificant stream in the cold and hot seasons and the ordinary monsoon rains often leave it still fordable, it is indeed often possible to cross it dry-shod. The river, it is on record, has often risen and done damage on previous occasions. In 1748 a great flood is said to have swept away many people and wrought great havoc. The records of this flood are however very obscure and it may have been connected with the bursting of some ill-constructed dam to a reservoir or tank. The later records are of much greater importance. In 1871 the river rose with great rapidity drowning some 2,000 people and doing immense damage. Again in 1895 following tremendously heavy rain a rapid rise of

the river took place with loss of property. In October 1903 also it rose very high and numbers of people were drowned and many houses were demolished.

Five years later we have the great flood of September 1908.

Now what is the cause of the rapid rise of the water in a river of such insignificant size as the Musi? Heavy and continuous rainfall will of course fill up any river, but Nature has, under normal conditions, usually provided for the running off of the excess, as we see so constantly in India where a trickle of water in the cold and hot weather is provided with a river bed of perhaps several hundred yards broad. Why should the bed of the Musi appear to have become, during the last 30 years, too small for the volume of water it has to carry during heavy bursts of rain? It is a fact now well understood that in an area covered with forest the water falling during a heavy shower drains off from the area at a far slower rate than that falling on an area of similar extent out in the open country. Consequently that if you remove the forest over large areas adjacent to the course of a river and round its head waters the river during heavy falls of rain will fill much more rapidly than would be the case were its head-waters and banks sufficiently afforested. This is what has recently happened in the case of the Musi and has undoubtedly been the direct cause of the calamity at Hyderabad.

It may be asked on what grounds can such a statement or indictment be based. For years the destruction of forest in Hyderabad has been a matter of common knowledge, and fellings of young poles on the scale which has been effected, *e.g.*, in Medak and Indur, can lead to but one result. A careful perusal of all the information on the tragedy which filled the columns of the Press supplemented by a study of the Reports of the Hyderabad Forest Department of the last decade has, only too clearly, fixed where the responsibility falls, and points to the steps which it is a matter of imperative necessity should be taken if disasters of this nature are not to become more frequent and to attain even greater dimensions. We know the size of the Musi. An "insignificant stream," the Reporters in the Press termed it. What it may be imagined would happen if rivers of the size of the Kistna or Godavari

followed the example of the Musi. And yet this river flows into the Kistna and the second Hyderabad river, the Manjra, which rises in the Bhir District, joins the Godavari after a course of 387 miles. Either river is subject to inundations such as recently followed the rising of the Musi unless the Government of Hyderabad follow a more enlightened forest policy than has been theirs during the past decade and more.

In searching old records on the forest policy of H. H. the Nizam's Government, or rather on the absence of it, in old times, the following instructive criticism, penned in 1889, came to light:— "For the last ten years the denudation of forest has been carried on in His Highness the Nizam's territories and notably in the forests of the great *jagirdars*: these are still being encroached upon in a manner which is highly injurious to the most vital interests of the country. For the purposes of present gain, immense tracts of forest have been sold to rapacious contractors, who have cut down indiscriminately all descriptions of trees: grand old banyans and *pipal* trees, the growth of hundreds of years, have been destroyed to furnish fuel for the railway, the cotton mills, and rafters for the houses of village communities. With such recklessness has denudation progressed that on some tracts not a seed bearing tree has been left standing for the purpose of natural reforestation." This crushing indictment was written near two decades ago. It will be of interest to see how matters have been going since that period in the forests of the Dominion. Data of very considerable importance are to be found in the pages of the Report for 1895-96, from a comprehensive review of which the following extracts would seem to have a peculiar significance at the present juncture. We read:—

"This is the first printed report which the State has issued since forest conservancy began, and we are much disappointed at the signs which appear in the review by the State Board of Revenue that forest conservancy is not viewed with as much interest by the State authorities in Hyderabad as it is in some other Native States we could mention. From our knowledge of the eastern boundaries of the State, at any rate, there must be a considerable area of fine and valuable forest which should be taken care of and

properly managed—and we hope that future reports will show at least some larger meed of sympathy with the struggles of a new Department than is evidenced in the Board's Review, and the remarks in it by their second member. The introduction of forest conservancy in the Provinces of British India, followed by similar work in the chief Native States, has naturally at first met with much opposition, an opposition which by degrees has diminished, as it may be hoped it will in Hyderabad, with the perseverance of the officers appointed. But it does seem hard that a Government or State should appoint officers to carry out the management of a portion of its estates and then throw obstacles in their way and treat them as if they were speculators trying to make personal capital out of their work, instead of zealous and hardworking men trying to do their best for their employers.

The area of reserved forest at the end of the year amounted to 3,752 square miles, most of which, as might be expected, was in the Warangal District. Proposals for a further area of 1,225 square miles are before the Board, and a further area of 731 square miles has been selected. On the subject of the area which the department should control the Board say :—

'In the opinion of the Board of Revenue, the policy should be to take up all necessary reserves and then to confine the operations of the Forest Department to these areas alone, leaving the open forest under the revenue officers. It is impossible in the present state of the revenues to provide sufficient expenditure for the adequate supervision by the Forest Department of both the open and the reserved forests. The whole energy of the Department should therefore be concentrated on the reserves. It would be better that the Forest Department should not be represented at all in the open forests, and that these be left to the Revenue Department, which works through the *patels* of villages, rather than that the Forest Department be represented in a *taluka*, where there is a considerable area of forest by a *single chowkidar*. The single *chowkidars* could be much more usefully employed in one of the reserves where, although there has been some increase of establishment, the number of subordinates is still said to be too limited.'

It is difficult for us, without more specific knowledge of the circumstances, to give an opinion on this very difficult question; but we venture to point out that although *primâ facie* the Board's views would seem to be the correct policy and to be what the Department itself would like, there is another side to the question and that is the very great probability that before many years are out the 'open forest' will cease to exist, and there will then arise an outcry calling for the excision of parts of the reserved area, and by degrees a whittling down of that area until little, if anything, remains. We are more inclined for our part to think that reservation of all forest lands will be the best policy, and that the management of the lands should be so adapted as to meet first of all the wants of the people in such a way as to maintain the whole area in as good and as increasingly improving a condition as possible, consistent with the supply of those wants. The better forests can always be managed in a stricter way for the supply of higher class material, but the whole should be maintained instead of keeping up merely the better parts and allowing the rest to gradually disappear. At present, in the open forest, the control of the Department is confined to the protection of a few reserved trees and the rest of the trees and all minor products are looked after by the Revenue Department. No wonder the Conservator says: "Illicit felling, fire, excessive grazing, the axe of the herdsman, and the shepherd and all the enemies to which a forest can be subjected combine to denude and destroy the open forests."

In the light of the recent events at Hyderabad much of what is written above seems to have been penned almost with the pen of prophecy. The following year, 1896-97, our reviewer has more to say upon the same subject:—

"The chief interest in the report consists in the references to the condition and future of the open forests an all important quesion. We can well understand that with many conflicting interests, the Nizam's Government finds the wholesale or partial reservation of these tracts a difficult matter to decide upon, as also that a large increase in the forest establishment cannot readily be acquiesced in. But when we read that these forests, 'are annually diminishing

in area and deteriorating in quality,' though '*most of the valuable forest tracts are still in the open forests*,' that no establishment is kept up by the revenue authorities, while that 'maintained by the Forest Department is inadequate to protect the reserved species,' that ryots who are entitled to free timber, etc., sell the surplus of what they take out and do not require themselves, 'whilst as a matter of fact the general public take what they require (among unreserved species) without payment, cutting in a reckless and extravagant manner', and finally from the Conservator's complaints of the numerous serious illicit fellings made chiefly along the boundaries of *jagirs* and *maktas*, and sometimes accompanied by extreme lawlessness—it is evident that the administration is carried on with great laxity and that the Department gets all too little help from the revenue authorities.

Under 'protection of the forests from injury' Rs. 16,521 were realised as compensation for illicit fellings in 2,295 cases, an increase on the previous year, due to four times the value of the stolen property instead of twice only, being allowed to be taken: 1,632 cases were reported from the Bider Division alone, and this apart from the fact that many cases were not reported. 'Many thefts of the boldest character were reported and some forest guards were severely handled.' There were 47 court cases, of which 12, including 4 convictions, were disposed of and 35 left pending! Of one case against a *jagirdar* for stealing timber it is remarked that 'it was the first case of its sort in which it has ever been found possible to get a conviction' What further comment is necessary! A Forest Act, drafted on the same lines as the Berar Forest Act, was before the Legislative Council at the end of the year. It is badly needed! Fire-protection was started during the year. Even in this famine year most of the forests were burnt, with disastrous effects to the cattle, of which it was estimated that in the Bider Division only 20 to 30 per cent survived, while the price of grass went up enormously. Deplorable damage was done to all species in Government forests in the efforts of the villagers to save their cattle by pollarding the trees. We are very far from agreeing with the Board in their policy of auctioning reserves for grazing."

In a review of the Report for the year 1897-98 the reviewer thus commented upon the position of affairs in Hyderabad :

"In order to understand the present position of forestry in Hyderabad, the Administration Report of the Forest Department for Fasli 1307 (1897-98) calls for consideration. In that year three small reserves were created and 13 remained pending. Fire-protection was attempted under very great difficulties. Grazing fees in different reserves were assimilated to one another ; those for reserves being collected by the Forest Department, and those for open forests by the Customs Department. The revenue was Rs. 3,67,721, the highest on record, having more than trebled in nine years. The expenditure was Rs. 1,28,438 leaving a surplus of Rs. 2,39,283. In the year 1307 Fasli, the Mowra revenue in reserves was collected by revenue officials, and it was not credited to the Forest Department. In spite of every effort, permission to appoint the small newly sanctioned establishment could not be obtained within the year, much loss thereby being caused.

At the present moment the forests consist of eleven 'Reserves' and much 'Open Forest'. In the latter only 16 species of trees are protected, and people generally may help themselves to whatever they please. At least 600 square miles of open forest ought to be reserved at once, and every year's delay assuredly means, as the Conservator pointed out, increased loss and difficulty. There are boundary disputes with *jagirdars* all round and settlements are exceedingly difficult to obtain. Some of the best forests have been included in *Shikar* Reserves and the interference of the *Shikari* establishment has been very detrimental to progress. The Forest Officers ought to be able to show as good sport as any professional *Shikaris*, and the latter should be entirely excluded from Reserves as far as any interference with management is concerned.

The people get everything they want free, or at nominal fees, and are exterminating bamboos over large areas. The Board, when asked to introduce restrictions, replies that bamboos are a necessity, and the people must have them ; but the Board does not go on to explain where the people are to get them from in the

immediate future, and how they will manage about the 'must have them' when there are none left in the forests.

The proceedings of the Board of Revenue on the annual forest report for the year 1307 F. give a clue to the attitude of H. H. the Nizam's Government. The Board is not absolutely unfriendly to forests, but it is terribly dilatory. It seems to think that while it is holding back from action, the people are also holding back from destruction. It permits its Revenue Officers to defy and act in contravention of its own orders with impunity.

Jagirdars, too, are allowed to procrastinate or defy orders in the matter of demarcation. So long as a *jagir* is not demarcated, even though it contains nothing bigger than the wrist, the *jagirdar* can sit down at the receipt of custom and issue passes for timber which he knows and intends will come out of the adjoining Government forest.

There are many thousands of goats in reserves, the property of residents; but in the open forests they are innumerable and browse freely throughout the best areas. The result is deplorable and disastrous. The Chinur forests used to be quite the best in Bider, but have deteriorated badly. Bijasal trees, 3 to 7 feet in girth, worth Rs. 15 each, were felled by hundreds by herdsmen for fodder during the scarcity, the establishment being quite inadequate to check the evil. The general attitude of the Nizam's Government, in fact, is one of procrastination and obstruction. The Forest Department is not allowed to take the management of forest matters out of 'revenue' hands, because the weakness of the forest staff would cause inconvenience to the people. The forest staff cannot be increased, because 43 per cent of forest revenue is already devoted to forest expenditure! As if that had anything to do with it! Surely, if the Nizam's Government had due regard to its responsibilities, it would see that its duty to the State requires it to spend the whole of the forest revenue, and in all probability even additional subventions, now and for years to come.

The Chief Engineer for Irrigation in his Annual Report lays stress on the necessity for reserving all the forests on the Medak hills, *the gradual denudation of which has led to the silting up of*

tanks besides proving prejudicial in many other ways to the interests of Government from an irrigation point of view. The Conservator winds up his Report for this year with the remark 'I much regret to state that the Forest Law, which was originally submitted to Government some six years ago, is still unsanctioned. I have repeatedly pointed out how impossible it is to enforce the rules of the Department aided only by the Circulars of Government through which the Department is at present worked, and which do not provide for the punishment of offenders, who are quite aware of the fact that they can evade or violate departmental rules with impunity'."

Two years later (1899-1900) this Law was in force so far as its position on the statutes was concerned. As regards its practical application, however, we read in the 1899-1900 report as follows:—

"Again with regard to establishment the Legislative Council has passed a Forest Law which regulates the procedure to be adopted in forming new reserves. It enacts that the area must first be properly surveyed and mapped—reasonable and necessary enough provision—but it puts an effectual stop on further reservation because the Government persistently declines to sanction any survey or mapping establishment. If this was meant to stop further reservation it was really a most ingenious and effectual way to set about it.

The forests are divided into reserved forests and open forests, the extent of the latter is unknown, but is something very great. Of reserved forests there were at the close of last year 4,765 square miles; the addition of 245 square miles during the year brought the total up to 5,010 square miles, which is but an insignificant fraction of the area, which is covered with valuable forest in the Nizam's Dominions. To work this area there is a controlling staff of one Conservator, five Assistant Conservators and one Sub-Assistant Conservator; and an executive staff of fifteen rangers, thirty-eight foresters, and two hundred and ninety-eight guards.

Settlement, what there is of it, is much impeded by procrastination of certain of the revenue authorities and by the countless

boundary disputes which are inevitable when the Government forests are surrounded by innumerable private *jagirs*.

Altogether things are in a bad way in Hyderabad, and it will not be many years before it is too late to take the steps which ought to have been taken some time ago, if His Highness is desirous of retaining those forests for which Hyderabad has long been famous. Unless the State is prepared in future to spend large sums in attempting to restock its denuded areas, it will be of little purpose extending reservation to such areas after they have been stripped of all valuable forest growth."

A year later a reviewer of the forest report (1900-01) writes:— "His Highness the Nizam cannot be congratulated on the progress made in forest administration within his dominions during Fasli 1310. Matters seem to be at a stand-still or rather progress is at a stand-still, and forest growth is fast disappearing or, at any rate, deteriorating.

The condition of the open forest is especially unsatisfactory. They are nominally in charge of the Tahsildars, who are allowed no establishment for the protection and working of these forests. Their interest in such areas is consequently limited to obtaining what revenue they can from them."

Four years later (1904-05, the last report on which a Government resolution is available) we find that the nominal area of the reserves is 5,247 square miles (an increase of 237 square miles only), of protected forest 4,451 square miles, and of open or unclassed forests 2,041 square miles. The staff had now been increased by one assistant, six sub-assistants, twenty-three rangers and foresters and one hundred and fifty-nine guards.

The demarcation and survey of the forest appears to be much in the same state as complained of several years before and this is the kernel of the whole situation down in Hyderabad. Without a system of thorough surveys and demarcation of boundaries on the ground forest reservation remains a dead letter, for it is, of course, impossible to prosecute a man who extends his cultivation over the boundary into a reserve if there is no map by which the boundary of the forest may be proved in a court of law. Nor without

such boundaries definitely laid down on the ground is it possible to stop illicit fellings in, and robberies from, the reserves.

A perusal of the report clearly shows that whether with the connivance of the revenue authorities or not, the constitution of the State forests in these matters is in a very backward state, and that the progress made after so many years work is extremely poor.

Of working-plans there are none and this want is easily explained, for in the absence of good forest maps it is quite impossible to draw up such plans. Nor would it appear that they are desired by those officers of the Nizam's Government who are chiefly interested in ensuring that the forests are left to the lumberman and the villager as long as they contain anything valuable in them. It is this connivance on the part of the lesser authorities of the Nizam's Government, combined with the squabbles over boundaries taking place with the big and powerful *jagirdars* who have for years been felling on a large scale, either in their own forests, if they possessed any or in Government forests adjacent to their *jagirs*, if they had none, which is responsible for the silting up of the tanks of the country, for the drying up of springs, and for the sudden terrific inundations: for one and all these result from the general ruin of the forest which is being so systematically carried out, a ruin from which it will take the Forest Department many years to rehabilitate them or those of them which are not entirely destroyed. There is said to be a dearth of natural reproduction in the forests. Excessive grazing, fire, and drought have between them seen to this and without young growth how does the Nizam's Government expect that the forests will continue to remain such? Already, as we have seen, the Chief Irrigation Engineer is complaining about the decrease in the water-supply. With 83 per cent of the forest area open to goat-grazing and with heavy fellings of young poles allowed in valuable forests, there seem to be the most grave reasons for fearing that Hyderabad will have to face in the future, and at shorter recurring intervals, yet more serious disasters than the one which has lately visited it.

While sympathising in common with the world at large with those so suddenly struck down in an appalling calamity, the writer

believes that the true reasons which preceded and led up to the disaster should be plainly pointed out. A parsimonious policy for years prevented the Forest Department of the Nizam's Government being anything more than a name in the State. It is still but little more. As in the old days in British India, the advent of a Forest Department was loudly proclaimed beforehand and the fiat went forth amongst the people to fell whilst there was yet time. Time in plenty has been afforded by the slow working of the State machinery in Hyderabad and the saving of the few lakhs of rupees required for the proper conservation of the forests in days gone by has resulted in a terrible loss of life and in destruction of property amounting to many crores of rupees. Difficult will it be for the procrastinators of the Nizam's Government to divest themselves from the responsibility of these happenings.—(*The Pioneer*)

ORIGINAL ARTICLES.

C. P. FOREST CONFERENCE

The first Provincial Forest Conference to be held in the C. P. on the lines suggested by the late Inspector General of Forests, Mr. Eardley Wilmot, C.I.E., took place at Nagpur during the latter part of November last.

Invitations were issued to Forest Officers in other provinces and in Native States with the result that 10 officers availed themselves of the offer and assisted materially to forward the purpose of the Conference by the manner in which they joined in the discussions raised and gave their experiences of conditions in parts of India other than the C. P.

Mr. C. G. Rogers, Conservator of Forests, Berar Circle, undertook the whole arrangements for the Conference, and there is no doubt that to him and his lieutenant Mr. C. E. C. Cox, Assistant Conservator of Forests, the unqualified success of the Conference and the arrangements connected with it are due. No less than 33 Forest Officers, 23 from the C. P., 10 from other

Provinces and Native States assembled at Nagpur for the conference, and the housing and messing of this number entailed as may be imagined considerable trouble and forethought. Tents were obtained from adjoining Forest Divisions and sent in to Nagpur and two camps were pitched at Telenkheri, thanks to the courtesy of Mr Standen C.I.E., Director of Agriculture a few minutes walk from the new C. P Club, one for married officers and one for batchelors. Furniture was provided for those who required it and adequate arrangements were made for fuel and water.

Meals were taken at the C P. Club through the kindness of the Secretary who agreed to consider all officers attending the Conference, as Honorary Members of the Club for the time being, and also undertook to make all arrangements for messing Members of the Conference assembled at Nagpur on Sunday, 22nd November, and had that day to settle down comfortably in the excellent camp which they found pitched ready for them. With few exceptions, we all met that evening in the large dining room at the Club set apart for us, and it was a great pleasure to all of us renewing old acquaintances and at the same time making new ones.

The following is a complete list of officers who attended the Conference:—Messrs C. G Rogers, A V. Monro, A. E. Lowrie, C. Somers-Smith, A. M. F. Caccia, W. Fisher, H. E. Bartlett, A. St. V. Beechey, C. M. McCrie, D O Witt, A. P. Percival, A. D. Blascheck, H. L. Newman, J. D. Maitland Kirwan, C. A. von B. Malcolm, G. M. Townshend, J. Donald, P. S. Corbould, W. Best, C. F. Bell, M. R. K. Jerram, V. H. Forbes, C. E. C Cox, Rai Bahadur Mansukh Rai, Shrinivasalu Nayadu, Pandurang Narayan, A. L. Chatterjee, S G. Paranjpe, P. Shankarnath, Laxman Dass of Jodhpur, Narsingh Rao of Bhopal, Ganesh Lal of Alwar, E. A. Rooke of Bastar.

We must not omit to mention the names of those ladies who accompanied their husbands and materially assisted in the social part of the gathering, *viz.*, Mesdames Rogers, Monro, Witt and Corbould It is to be hoped that the initiative shown by these ladies will result, in future occasions, in a much larger proportion of officers being accompanied by their wives.

On Monday, 23rd November, the business of the Conference commenced. The meetings were held at the old museum near the Railway Station and about 2 miles from the camp. A large hall which appears to have done duty as a theatre, made a convenient and excellent meeting room. The first meeting was held at 11 A.M., and after some discussion it was decided that we should meet on alternate days at 11 A.M. and at 8 A.M. on the intervening days. Each meeting lasted about 3 hours, it being wisely decided that longer periods of discussion would result in a waning interest and militate against the framing of definite resolutions on the subjects under discussion.

The general procedure adopted for the course of the Conference was to take the paper under discussion as read, to ask the member whose paper was before the meeting to introduce the same with a few preliminary remarks, and then to invite criticisms and questions from different members in turn. The procedure adopted worked very satisfactorily, a slight tendency at the outset for the discussion to degenerate into desultory conversation being rightly repressed by our chairman Mr. C. G. Rogers. Here and there an over-enthusiastic member was inclined to bring forward unimportant details for discussion, but was soon charmed back to the broad path by our watchful chairman. When the actual results of the Conference are duly published as may be expected shortly, a perusal of them will, we feel sure, justify the remark that, taking everything into consideration, the Conference was an unqualified success, and achieved definite results.

A short notice on each paper read and discussed will not be out of place, but it will be of the briefest as full details will be found in the report which is about to be published The notices are given in the order in which the papers were taken up.

23rd November. —"The Collection of Statistical Data relating to the principal Indian Species" by Mr. A. M. Caccia, M.V.O., Deputy Conservator of Forests. This paper may perhaps be considered the most important of all that were discussed before the Conference. Unfortunately, the paper had not been

sufficiently long in the hands of some members of the Conference to receive the careful study it deserved, but criticism was forthcoming in sufficient quantity to raise a lively discussion. It was found that owing to the variety of statistical data touched on in the paper, it was impossible to discuss more than the broad principles enunciated therein, the most important being perhaps that the general direction of the collection of statistical data should be vested in the Research Officers of the working Plans Branch of the Imperial Forest Research Institute. This main principle was duly accepted by the Conference.

It was found impossible to dispose of this paper at the one meeting; a second day, the 30th November, was therefore given to its discussion, when a number of resolutions which it is hoped will shortly bear fruit, were passed.

The following members were prominent speakers in the discussion on this paper: Messrs. Rogers, Caccia, Blascheck, Fisher, Jerram, Maitland Kirwan, and Percival

24th November.—" The Propagation and Collection of Lac " by Mr. A. E. Lowrie, Deputy Conservator of Forests. Mr. Lowrie drew attention to the latent source of revenue awaiting development by the scientific cultivation on a large scale of this important item of minor forest produce, and showed us what can be done by good management. The expediency of departmental work as opposed to contractors was discussed and the question as to how far lac injuriously affects the quality of the wood of the infected trees. This latter question arose out of some interesting information given by Mr. Maitland-Kirwan who pointed out that, in Sind, lac is almost exclusively cultivated on Babul (*Acacia arabica*) which is primarily grown for its timber Information was communicated by Mr. Caccia relating to improved methods of preparing shellac from the crude lac, and it was suggested that a lac factory might be started by Government in the C. P. to improve the present methods of manufacture.

Amongst those who spoke may be mentioned Messrs. Lowrie, Caccia, Maitland-Kirwan, Witt, Somers-Smith, Mansukh Rai, Donald, Paranjpe.

25th November.—"The Mixed Teak Forests of the Saugor Division, Northern Circle, C.P., and their Treatment" by Mr. C.M. McCrie, Deputy Conservator of Forests. This paper dealt mainly with the Coppice with Standard system of management now so general in the C.P., and, as was to be expected, led to a lively discussion on the merits of the system, the adaptability of Teak to reproduce itself by coppice shoots, the method of felling best suited to obtain reproduction by coppice shoots, the best period of felling, and the causes which affect the frequent production of imperfectly lignified shoots which take on a creeping habit instead of growing erect.

The following members joined in the discussion: Messrs. Rogers, McCrie, Caccia, Fisher, Witt, Newman, Donald, Malcolm, Somers-Smith, Lowrie.

26th November.—Two papers were discussed on this day. "The Allapilli Monorail Tramway" by Mr. J. Donald, Deputy Conservator of Forests; and "The Germination and Development of *Hardwickia binata* (Anjan)," by Mr D. O. Witt, Deputy Conservator of Forests. The discussion on the first of these two papers was mainly confined to a duel between the partisans of monorail traction as represented by Mr. Percival and of two wheeled traction, as represented by Mr. Donald. The general consensus of opinion appeared to be in favour of two-wheeled traction, except in very special circumstances.

The chief speakers were Messrs. Donald, Percival, Fisher, Best, and Rogers.

Discussion on the second paper was somewhat limited, due, no doubt, to the fact that only a small proportion of the members present had had experience of the species. The curious habit of the seedlings of dying back, year after year, came under comment and experiments were suggested for studying this phenomenon not only in Anjan but other species such as *Sal* and *Saj*.

Members who spoke were Messrs. Witt, Caccia, Fisher, Newman, Donald, Shriniwasalu.

27th November.—"The Influence of, or Protection from, Cattle-grazing in the Forests of the Bhandara Division, Southern Circle,

C. P.," by the Hon'ble J. W. Best, Deputy Conservator of Forests. This paper produced an animated discussion on a very thorny and much debated subject. The grazing question may be said to be acute in some parts of the C. P. at the present time, and it was realized that something more is wanted than mere generalisations on the subject of over-grazing, and that investigations are urgently required to produce facts and figures to show what limitations are necessary to ensure the permanence of any particular class of forest.

The following members, amongst others, joined in the discussion: Messrs. Best, Caccia, Fisher, Witt, Percival, Lowrie and Donald.

28th November.—" The Distribution and Cultivation of *Acacia arabica* (Babul) in Berar" by Mr. Shrinivasalu Nayadu, Extra Assistant Conservator of Forests. This paper led to an interesting discussion on the methods of growing Babul Forests and showed that there was a good deal of difference of opinion as to the treatment of Babul in the seedling stage, more especially with reference to the exclusion or otherwise of grazing. Forest Officers, both in Berar and the Bombay Presidency, were strongly in favour of grazing as opposed to weeding to prevent the seedlings being choked by grass and weeds.

The question of cleanings and thinnings in Babul forests led to a discussion on the meaning of a cleaning as opposed to a thinning, and brought to light considerable divergence of opinion.

The principal speakers were Messrs. Shrinivasalu, Maitland-Kirwan, Newman, Caccia, Fisher, Blascheck, Malcolm and Rogers.

The last meeting, that on 1st December, was taken up with going over the various resolutions which had been framed, amending them where necessary and passing them, as well as discussing arrangements for next year's Conference. The possibility of making Jubbulpore the place of meeting was brought forward but nothing was finally decided.

The Conference was finally closed with a vote of thanks to the chairman, Mr. C. G. Rogers, for the great trouble he had taken to make the Conference the success all felt it had been. The proposal

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by Barrington Moore.

Muraghat Block, Jalpaiguri Division.

Showing dense evergreen undergrowth which comes in under Sal and prevents reproduction.

was made by Mr. Caccia, seconded by Mr. Witt, and carried unanimously.

The hours fixed for the meetings gave a good deal of spare time in between, which members found no difficulty in filling up with visits to the C. P. and Berar Industrial Exhibition, for which all officers as exhibitors in the Forest Section obtained free passes. A Durbar of Feudatory Chiefs and Zamindars at Government House, followed by a garden party and a Coopers Hill dinner attended by 30 old Coopers Hill men were amongst our diversions.

CAMP JHIRPA, *January 21st, 1909.*

D. O. WITT,
Depy. Conservator of Forests.

NOTES ON THE FORESTS OF NORTHERN INDIA AND BURMA.

BY BARRINGTON MOORE, M.F.*

I.—Introduction.

This does not pretend to be a description of conditions in the forests of Northern India and Burma, but merely a few notes on the way in which certain things in these regions appeared to an outsider accustomed to an entirely different set of conditions. The comments will be made on things just as they struck the observer without any attempt to present especially the more favourable side, and suggestions given wherever occasion seems to arise. If anything which may be said happens to give offence to any one, it must be remembered that it comes from a keen interest in the welfare of Forestry in India rather than from any desire to detract from the work which is being done.

II.—Coniferous Forests of the Himalayas.

(*a*) Deodar, spruce and fir.

The most striking feature of these forests is the great proportion of very large mature and over-mature spruce and fir, all of which is absolutely useless owing to its inacessibility. Some

* M. F. represents the degree of Master of Forestry of the Yale University.—Hon. Ed.

of these trees on moist northern aspects are four feet and over in diameter at breast height, and as much as a hundred feet of clear bole. The timber they would yield is in no way inferior to that of the American red spruce (*Picea rubra*) or the European spruce and silver fir. Though it could not be used in India for building on account of white-ants, it might be exported to Europe if a market could be worked up for it, and it certainly could be used for pulp. The difficulty of extraction might be overcome by cutting the logs into short lengths, so as to enable it to dry quickly and float, and rolling these lengths down the slopes into the streams. Attempts are being made to solve this problem, and it is to be hoped that they will succeed, because, until they do, the returns from these forests will remain far below their possibility. Another point is that on the type in which deodar occurs in mixture with the spruce and fir there is no hope of keeping the present proportion of deodar until the spruce and fir can be exploited.

There should also be an attempt to create more of a demand for the blue pine (*Pinus excelsa*) than there is at present, because of its rapid growth and excellent reproduction. At the same time it might be possible to profitably tap the blue pine for turpentine in areas where there is enough of it and it is near enough to a market.

The management of deodar which is the most important tree of the region, and undoubtedly always will be, is in general all that could be desired. It is on the group selection system, with the size of the groups left to the judgment of the Forest Officer within certain limits.

The tendency is, as it should be, to increase the size of the groups on account of the light demanding quality of the tree where this is possible without too much danger of exposing the soil.

(*b*) Chir pine forests (*Pinus longifolia*).

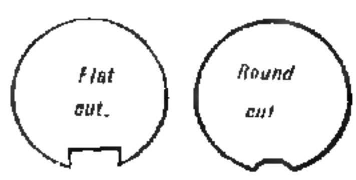
One of the difficulties of management in these forests is the smallness of the market for pine timber. In a good many instances the demand is purely local. At present the wood can scarcely be sold in the plains because the people are accustomed

to using sal on account of its white ant resisting property. There are however a good many uses such as interior carpentry, box making, etc., to which it could be put if only the market were worked up for it.

The system of management is now being made to suit the light demanding nature of the tree. In forests where the selection system is still prescribed they try to make the fellings in groups as far as possible. But with the small number of trees allowed for cutting in each compartment under the working-plan it is generally impossible to make effective openings. Hence the selection system should without doubt be given up altogether, and either the group system or uniform method adopted. In divisions for which working-plans have been more or less recently made this has been recognised, and the forests are therefore being well managed.

One of the most important products of these forests is turpentine. The progress made in the development of this important industry has been remarkable. The only faults noticeable are due entirely to its newness.

They are of two kinds—(1) in the actual tapping, (2) in the prescriptions for tapping. Under (1) the first is that the gutter or lip is put some distance below the top of the former years' cut in moving it up at the beginning of each season, and in tapping a tree for the first time the gutter is put in the bark below the cut instead of at the base of the cut. The object is to save resin, but it actually wastes more than it saves, though it is not of very great importance either way. The second defect under (1) is that the cut is made flat instead of round, and rather broader and deeper than necessary. A round cut of much less width would sever as many ducts and give as large a flow of resin as the flat cut: because it is obvious that in a flat cut very little resin will come from the side of the cut, since the wood there is torn instead of being cut across.



Cross-section of trunk

The third fault is that the cut is made to run perpendicularly to the ground instead of to follow the axis of the tree. In the French turpentine forests there is a very strict rule against making the cut any way but parallel with the axis of the tree. The faults under (2) are—first, not always tapping to death trees which are to be taken in fellings, thus failing to utilise a large amount of resin. This is the case under the selection system of fellings and is another of the defects of that system. Secondly, restricting the amount of tapping which shall be done on a tree which is to be tapped to death. Thirdly, having too long a rest period between tappings. In France trees tapped lightly (*gemme a vie*) sometimes have a rest period of five years and sometimes no rest period at all. A single cut, if not too wide, ought not to hurt a large tree.

The faults in the actual tapping are due, as said before, to newness, and are easily corrected. Those in the prescriptions for tapping are due to over-conservativeness, and are the natural result of the experimental stage in which the industry is at present. They are erring in the right direction, because it is far better to go slowly until one is perfectly sure, and are therefore much more to be praised than blamed.

III. Sal of the United Provinces

Here there is no such difficulty about the market as we have noticed in the two preceding regions. Every stick of sal can be utilised and more too. The demand for other species occurring in the region is not great, but this does not matter because in a sal forest treated as it should be the crop is practically pure. There may be a certain amount of sain (*Terminalia tomentosa*) on the heavier clay soils, but the demand for this species is rapidly increasing, making it also a desirable tree.

The management of sal was first on the selection system, perhaps started before there had been time to study sufficiently the sylvicultural requirements of the tree. At present it is becoming recognised that some more open method such as the group system is needed, because sal in its natural condition always grows best

in pure, even aged forests. Hence when once the reproduction on the ground has been *assured*, the forest should be well opened out. A case in point was seen of a forest in which the former Inspector-General Mr. Eardley-Wilmot had made rather heavy fellings while Divisional Officer. The fellings were severely criticised at the time, it being stated that they were so heavy as to ruin the forest. At present the best young crop in the whole forest is in these very fellings.

The chief difficulty in the management of the tree is its susceptibility to damage by frost. Large areas were seen where practically every sal had been killed back at the top by this agency, and, though the tree may outwardly appear to recover, the decay which has set in from the dead top is rapidly moving down inside the stem. Great progress in the solution of this really difficult and important problem has been made by Mr. P. H. Clutterbuck through his observations while in charge of the Kheri Division. As these will probably shortly be published by Mr. Clutterbuck himself, it need only be mentioned here that they will throw important light on the influence of moisture in protecting forests against frost.

Another important step in the development of these forests is the discovery that sal can be successfully reproduced from seed. Large areas of grass covered blanks will be made productive by this discovery.

A large proportion of forests in the sal region were ruined by reckless cutting before being taken over. In such forests improvement fellings have been carried on for the last fifteen or twenty years with remarkable results. Although there is actually little exploitable material on hand at present, yet there is everywhere such a full stock of excellent young growth that the future of these forests seems very bright.

IV.—Sal of Assam.

Conditions here are entirely different from those in the United Provinces. The forests are more remote and cost of extraction greater, thus limiting the number of purchasers and

lessening the price obtained for the timber. This means of course that operations must be much less intensive than they are in the United Provinces.

The fundamental difference however is due to climatic factors. There is no Dadu (cold wind) coming down from the hills to give the frost problem. On the other hand, the excessive moisture in Assam creates a problem which, until it is satisfactorily solved, does far more damage than the frost. It causes such a luxuriant undergrowth of small tree species, shrubs and creepers to come up under the sal that in a forest which has been protected from fire for a number of years, the future regeneration of sal is virtually impossible. When the forests were first taken over they had been continually burned, but were of pure sal with abundant reproduction. It is true that the reproduction was killed back a good many times before it finally came up, but a sal seedling dies back a good many times anyhow before it gets its roots down to perennial moisture; and it might just as well be killed back by fire which at the same time destroys its enemies, as to die back for any other reason; especially since the undergrowth comes up very much weakened or not at all after a fire, whereas the sal comes up again as vigorously as ever.

Attempts at solving the problem by cultural operations, such as cleanings to free the young seedlings after felling cannot be said to be successful. These cleanings affect only such seedlings as were on the ground before the felling, which are few and far between, and make no attempt to induce reproduction, because this would involve the impossible task of cleaning the whole area Even though successful in saving a few seedlings these operations are expensive and must be repeated every year for at least five years. It is really hopeless to attempt to keep back the enormous luxuriance of that undergrowth by such a puny operation as cutting it back by hand.

Obviously the only alternative is to burn this undergrowth, and experiments are being carried on to prove the necessity of fire and the best method of applying it. Any one who considers the use of fire as a breach of all the laws of sylviculture need only see the

excellent condition of a forest continually burned and then protected for one year [Kahriabunda Forest in the Jalpaiguri Division (*vide* Plate 10) which has been only recently reserved], where you find all ages represented by different groups of sal with practically no admixture of inferior species, and *no creepers*, and remarkably thick patches of reproduction wherever you have an opening. Then compare this with any forest which has been protected a number of years where you find inferior species coming in, the main crop damaged by creepers, and any reproduction whatever absolutely prevented by a dense mass of undergrowth (*vide* Plate 11). The experiments have not been carried out long enough to give any information as to the details of when or for how many years to apply the fire, but these can be worked out as the fellings progress

Valuable observations on this point have been made by Mr. W. F. Perrée while in charge of Goalpara Division, which it is hoped will soon be published in the form of a monograph and which will certainly tend to clear up this most interesting and important problem.

(*To be continued.*)

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE SPORTSMAN IN BURMA.

I. THE COUNTRY AND ITS SPORTING POSSIBILITIES

After a residence of nearly thirty years in Burma, I have often been struck at the great lack of knowledge and of interest displayed by the average stay-at-home Britisher in this, the largest of the provinces comprising the Indian Empire. From the tourists' point of view this interesting country is, and must be, most facinating and of late years, owing chiefly to the facilities afforded by the Bibby line of steamers, Rangoon is placed within three weeks of the port of Marseilles. Consequently, tourists have paid

great attention to Burma, and during the winter season, extending from November to March, a stream of eager sightseers invades the land, and, from the numerous books, pamphlets and articles written on their impressions of Burma, it appears to possess all the fascination held by Japan, Java, or other famous touring grounds. The object of this article is not, however, to draw the attention of tourists to this beautiful and interesting country, for that has been already done by the admirable books that have been written on it from time to time by Sir George Scott, Mr. Fielding Hall, Mr. Scott O'Connor, and others, but rather to draw the attention of sportsmen and other readers of the *Field* to the splendid varieties of big game which are to be found in its extensive forests and to give such information from my own actual experience as may be of benefit to those who, hearing of its capabilities from a "shooting" point of view, may be tempted to undertake an expedition into those happy hunting grounds

To one who has had experience in big game shooting in India, the conditions prevailing in Burma will be found totally different In India itself, owing to the density of the population and its annual increase, the bulk of the cultivable land has already been cleared of jungle and brought under the plough, so that, with the exception of the Terai, of Nepal and Bhutan, the forests of Mysore, Coorg and Travancore, and the sparsely inhabited parts of Eastern Bengal and Assam, no vast tracts of jungle-covered land are to be met with, such forests or jungles as there may be being like oases within miles upon miles of cultivated plains. To beat such limited tracts for tiger, deer, or other big game will therefore be an easy task. In Burma, however, the conditions are altogether different. Out of a total area of nearly 280,000 square miles the area of cultivated land is barely one-tenth, and hence the hunter of big game has the choice of hundreds of miles of forests seldom trod by the foot of man. From a glance at the map of Burma it will be seen that three more or less parallel ranges of mountains extend throughout the country, the most western extending from the Lushai Hills of Assam to Cape Negrais, the shorter central range extending through the old province of Pegu, and the

eastern range extending from Yunnan on the north, skirting the Shan States, and further south forming the boundary between Burma and the kingdom of Siam.

It is in these mountain ranges and the approaches to them that the big game of Burma is to be found. Since the year 1887, when the right to carry firearms by natives was withdrawn by the Government, game has increased and multiplied to a very large extent, especially deer, of which there are several species. But before proceeding to describe the big game procurable in Burmese jungles, it may be useful to prospective sportsmen if some details of equipment, transport, and camp life be given. The Burman or Karen "mok so," or "shikari" as he is called in India, is to be found in every village fringing the forests, where his presence as an armed hunter is much appreciated by the villagers as a protection from marauding elephants, cattle destroying tigers, and crop-devouring deer.

Through his agency no difficulty will be experienced in collecting villagers to act as porters for the expedition into the hills, and many pleasant days may be spent in tracking, or in sitting on a moonlight night in a *machan*, or platform in a tree, over a "salt-lick," to which from time to time all the denizens of the jungles resort, either to lick the salt or to prey upon other animals similarly occupied. My experience has been that no difficulty need arise as to an adequate supply of porters and trackers for such an expedition, for after the crops are gathered early in December the villagers are only too eager to follow the *thakin* into the forest wilds, provided they are supplied with food and are allowed the produce of the chase other than the trophies.

And very pleasant it is to form camp in a valley adjacent to a running stream, amidst the jungle and bamboo-covered hills, and from such centre to go off day after day tracking elephant, bison, tsine, rhino, bear, tiger and various species of deer. Tents are not necessary for such expeditions as the Burman forester is an adept in constructing temporary huts where bamboos are plentiful, and wild plaintain leaves form a sufficient protection from the heavy night dews. The principal animals to be found

in the forests of Burma are the elephant, rhinoceros (three species of which are common, *viz.*, *R. unicornis*, *R. sondaicus*, and *R. sumatrensis*), tapir, wild hog, gaur, tsine or banting (*Bos sondaicus*), and wild buffalo (*Bubalus arni*), tiger, leopard, the Malayan sun bear and the smaller *Helarctos euryspilus*, serow or wild goat, sambhur, hog deer, barking deer, and the diminutive mouse deer (*Meminna indica*).

It may also be interesting to note that during the winter months the lakes, jheels, fisheries, and creeks of Burma are the temporary feeding places of wild geese duck (fourteen species have been shot on one lake in Upper Burma), curlew, snipe, plover, and other wading birds which move southward at that season from their breeding haunts in Siberia. Expeditions after big game might therefore be varied by wildfowl shooting in the plains. With the exception of the elephant, no game is preserved, no license is required, and no fees are charged. The sportsman is at liberty to enter the forest and shoot all he can find. In the case, however, of reserved forests, conserved by the Forest Department, permission—readily granted to *bonâ fide* sportsmen—to enter may be obtained from the Conservator within whose jurisdiction the reserved forest is situated.

II.—ELEPHANT AND RHINOCEROS.

The elephant (*Elephas indicus*) is very plentiful in all the vast hill forests, which, as already explained, extend southwards in three more or less parallel ranges from Assam and China. By the Elephant Preservation Act of 1879 the catching or shooting of elephants is reserved as a Government monopoly, and under the rules the indiscriminate slaughter of this valuable animal was prohibited. *Bonâ fide* sportsmen, however, can obtain permission for the slaughter of a "tusker" from the Local Government through the Commissioner within whose jurisdiction the particular forest is situated. By a clause, however, in this Act, exception is made in the case where elephants become dangerous to man and destructive to crops, and in those districts through which these elephant forests run, information of such depredations by elephants is frequently

brought to the notice of the District Magistrate by the villagers, the latter either applying directly for permission to employ fire-arms themselves or desiring that some skilled hunter or sportsman may be sent to rid the district of the pest. The depredations of even one solitary bull among the cultivated fields skirting the forests are a source of great damage and loss to the villagers, and for this reason alone the arrival of a sportsman to rid the villagers of this destroyer is welcomed alike by the people and the executive officers of Government.

When traversing these forests in pursuit of big game one is struck with the sagacity shown by these immense beasts in having through the course of centuries established perfectly open tracks or paths ascending by easy gradients to the highest summits. Were it not for these clearly defined footpaths extending in all directions through these vast forests, access by the sportsman would be impossible.

Some four or five years ago the Keddah operations of the Government of India were removed from Assam to Burma, and a start was made in the Katha district of Upper Burma. These operations were so successful during the opening year that several hundred elephants were caught, many of which would eventually have been sold by Government at a good profit. Unfortunately, anthrax in a virulent form broke out amongst the impounded herd, and very few survived its ravages.

Although but little used in the present day by the Transport Department of the Indian Army, the demand for elephants for use in dragging timber from the forests to the navigable creeks is very large, while quite a number are employed at the saw mills in Rangoon and Moulmein, where their sagacity and cleverness in hauling logs from the river to the saw benches, and in removing the converted timber to the stacks, is one of the most interesting sights of these towns. To the Forest Officer they are invaluable as a means of transport for luggage in journeys where roads do not exist and other means of transport are unsuitable.

The forest of Burma can boast of no less than four kinds of rhinoceros. These are the *R. unicornis*, *R. sondaicus*,

R. sumatrensis, and *R. lasiotis*. The *R. unicornis* is fairly common in the Arakan Yomas, the Tenasserim province, and in the mountainous districts of Upper Burma. It has only one horn, which seldom exceeds 14 ins. in length. Its skin is very loose, and is distinguished by pronounced "shields" or "plates." The Javan rhinoceros (*R. sondaicus*) has less flabby hide and less pronounced "shields." *R. sumatrensis*, with two horns, is fairly common throughout Burma, more particularly in the Tenasserim province. It is smaller than the preceding one-horned species, and its body is covered with stiff black bristles. The hairy-eared rhinoceros (*R. lasiotis*) is now regarded as a mere variety of the Sumatran form (*R. sumatrensis*).

The rhinoceros frequents the upland forests in search of roots, bulbs, and fallen fruit, and is very fond of descending to swampy ground, where it loves to wallow like the water buffalo or hog. Its spoor is easy to track, owing to the impression made by the three prominent toes of the hoof. The curious fact that this animal usually chooses some particular spot in the jungle at which to drop its dung is of immense value to the sportsman, for if such a depôt can be come across the animal may be reckoned upon to be in its immediate vicinity, or if not it may be certain that he will return to the spot when necessity forces it.

When come upon suddenly in the jungles it scuttles off at a great pace, crashing through the undergrowth and taking the hillside almost as rapidly as the level ground. It is a clumsy, thick-headed, vindictive beast, and should your ·500 Express fail to bowl it over it at once charges full tilt, and the only chance the hunter has is to dodge in and out among the trees, and eventually to swing himself into the branches of one.

From a pecuniary point of view the shooting of rhinoceros is the most paying of all big game. Its horn is much sought after by Chinese doctors for medicinal purposes, and in Rangoon Rs. 500 is frequently given for one of fair size. Two or three such kills will therefore provide the sinews for the expenses of a three months' shoot.

The tapir (*Tapirus indicus*) is plentiful in the forests of Tavoy and Mergui, especially in the neighbourhood of the Great

Tenasserim River Some years ago the Commissioner at Tavoy had a tame specimen, which followed him about like a dog and lived for many years in captivity. The tapir is an exceedingly shy animal, essentially nocturnal in its habits, and distinguished by the white blanket-like appearance on its back. It frequents the uplands, and is seldom seen in the plains. *(By G. W. Bird in The Field).*

(To be continued.)

Photo.-Mechl. Dept., Thomason College, Roorkee. Photo. by Barrington Moore.

Large fir, (Abbies Webbiana) girdled to favor Deodar.

A striking example of the waste of a valuable wood on account of its inaccessibility.

VOLUME XXXV NUMBER 5

INDIAN FORESTER

MAY, 1909.

THE IMPORTANCE OF FOREST ENGINEERING

We are well aware that it is very easy for any one to maintain that a certain appointment is essentially necessary for the progress of their Department, but it seems always to be a very difficult matter to obtain sanction for a new appointment, however obviously necessary it may be. The case in point is the appointment of an officer as Specialist on Forest Engineering—an appointment which we consider is, in the immediate present, perhaps more urgently required than any other special post in the Department, for while the existing research appointments are more concerned with future developments, the Forest Engineering expert is required to elucidate all the problems for the facilitation of the transport of our products, which would find a ready market now if we only knew how to arrange economically for their exploitation.

The necessity for such an officer has been recognised at the Forest Conference recently held at Nagpur, where one of the resolutions passed was as follows:—(Resolution on the Allapilli Monorail Tramway, dated 26th November 1901) " . . II—That this Conference agrees that the question of transport is one of great

importance that has not received sufficient attention in these Provinces in the past. III—That the appointment in these Provinces of a specially trained Forest Officer to enquire into the conditions and possibilities of divisions where the local officers consider the existing transport arrangements are insufficient or might be improved, is urgently required."

It seems needless to state that what applies to the Central Provinces, applies with still greater force to several other Provinces where the forests are more valuable and the means of communication more backward.

At present, Forest Engineering is tacked on to the Economic Branch of the Research Institute. The officer in charge of that branch, if he is to carry out research work in order to develop the economic resources of our forests, will have his time fully occupied and cannot possibly give the requisite attention to the development of forest transport. His work, too, must often be rendered more or less abortive, for even when he has found a suitable product for a particular use, and a market could be developed, he has to reply in many cases, that though there are quantities of the product concerned in the forests, it cannot be taken out as there are no means of extracting it. We are assured that replies of this nature are the rule rather than the exception, and we are thus led to the conclusion that some action is necessary to improve matters.

Divisional Forest Officers cannot be expected to have all the knowledge necessary for laying out of tramways, monorails, wire rope-ways, and the like, and to be able to decide, without any experience to guide them, what form of transport is most suitable in each particular case. This is the work of an officer who can devote his whole time to the study of the subject. It would be his duty to keep up to date in transport methods, and advise officers on such projects. He might also be required to keep in touch with the firms who can supply the requisite materials for such works, so that accurate estimates could be drawn up.

In many cases, at present, the export from forests is limited to the most valuable species, often only one, because being so valuable it can be sold at a profit in spite of the crude arrangements for

transport. If the most suitable means of transport were applied—as they could be if we had a fuller grasp of the subject—there would remain in our forests few products which would not find a market. The forests could then be worked in a much more regular manner, the industries of the country would benefit by the increased output of raw material, and the financial gain would also be considerable. In many cases, we are now tied down to the selection method of treatment, chiefly because only one species, or so, of the crop is saleable under present conditions of transport. Whereas, could a market be found for all the species of the crop, the introduction of a more regular system of management would render the exploitation of the timber easier and cheaper still. What we wish to emphasize is that there exists, at this moment, a vast quantity of produce of all kinds in our forests which, under present conditions, we are not able to export, that suitable methods of transport are being applied in such cases in other countries, and that what we require is a special officer to study the subject and help the Department to apply suitable methods in India. We maintain that this is no uncertain goal to which we aspire, such as research in some other branches must often be, and that if a special officer is appointed to study the subject, we shall soon make enormous strides in the development of the rich resources of our forests.

SCIENTIFIC PAPERS.

AFFORESTING WASTE LANDS AND THE FINANCIAL RETURNS THEREFROM

BY A. D. WEBSTER.

Now that a timber famine is imminent and the Government is being urged to seriously consider the question of afforestation, it may be opportune on my part, as one of the earliest writers on the subject, to briefly recall what has already been

done in this matter, and to offer some remarks on planting waste lands, with special reference to cost and the financial returns therefrom.

In my long experience of British Forestry, which, in a practical way, has extended over a period of thirty years, I have become more and more convinced that, in order to place such on a systematic and sound economic footing, State aid and the afforesting of large areas of comparatively waste lands are first necessities. For fully a quarter of a century I have not failed to urge on the State and private owners of suitable land the pressing question of afforestation, and though in this matter a start has been made by the purchase of land in Scotland, yet such can only be looked upon has a half-hearted attempt to grapple with the question, and in a way quite unworthy of our country and the vast interests at stake. As early as 1883 I drew attention to the matter in "Woods and Forests," and at later periods in most of the leading journals and papers of the day; while, in my evidence given before the Select Committee on Forestry, and in a paper contributed by special request to the Board of Agriculture, I went fully into the question of afforesting, and pointed out what a boon to the unemployed and what a saving to the country would be effected by a well-organised scheme of tree planting. In connection with the afforesting of waste lands, I have travelled over many parts of the kingdom and examined much of the ground that could be set aside for this purpose, including the vast peat bogs of Ireland; while at various altitudes up to 1,100 ft., I have superintended the formation of plantations on the bare and wind-swept hills of Wales and Scotland, as also the gravelly and chalky common lands of several parts of England, both inland and on the coast. The above, combined with examinations of, and reports on, several of the largest woodland properties in this country which I have made at the request of the owners, have given me a wide insight into the forestry problem generally, but particularly with reference to our requirements in the near future as by far the largest timber importing country in the world —larger, indeed, than all the countries of Europe put together.

THE APPROACHING TIMBER FAMINE.

Than timber no article is probably more indispensable to the welfare of a nation, entering extensively as it does into almost every trade and industry. For England, therefore, with an ever increasing import, the possibility of a dearth of timber must be regarded with the keenest anxiety, more particularly as such would entail prohibitive prices and seriously cripple the trade of the country. The following table, as reported to the Washington Bureau of Manufactures, will show at a glance the annual imports of timber of the principal countries of Europe :—

England	16,342,600	cubic yards.	Italy ..	915,148	cubic yards.
Germany ..	11,766,667	,,	Denmark ..	849,630	,,
France ...	8,496,300	,,	Spain ..	392,222	,,
Belgium ...	1,897,777	,,	Switzerland ..	313,778	,,

In face of this it is only reasonable, therefore, to suppose that the Government should act promptly in the matter, remembering that no scheme of afforesting, however extensive or well ordered, can bring the necessary relief for at least forty years after its inception. For all this, and in spite of numerous warnings as to the pressing necessity for tree planting and the ominous signs of a timber famine, little or nothing has been done, save the holding of a few meetings by the Board of Agriculture and the purchase of a few hundred acres of waste land in Scotland. To sum up briefly, the situation is this :—England's imports have rapidly increased from a trifle under 3¼ million loads in 1864 to fully 10 million loads in 1906, thus showing an increment of fully 7 million loads in 42 years.

Most European countries have large internal supplies of timber, so that, by a system of conserving and protective tariffs, the pinch of want would not be felt severely for years to come. But not so England, which is almost wholly dependent on supplies sent from abroad

According to the Secretary of the Agricultural Department of Washington, the area of forests in the United States is 700 million acres, but even now the States are more or less dependent on Canada, and actually receive the entire surplus from that

country. But regarding the United States, President Roosevelt said: "If the present rate of forest destruction is allowed to continue with nothing to affect it, a timber famine in the future is inevitable. Remember that you can prevent such a famine occurring by wise action taken in time; but once the famine occurs there is no possible way of hurrying the growth of trees necessary to relieve it." Again, Mr. Lewis Miller, who has vast forests both in Sweden and Nova Scotia, tells me that in 25 years neither the United States nor Canada will have much timber left, while Sweden and Finland are already played out. "I am also of opinion," he says, "that during the next twenty-five years timber will be double its present price, and that it will not only pay to plant land valued at 3*s.* per acre, but that worth 20*s.* per acre." These are no idle words, but the records of those who know well what they are talking about; neither are they in any sense pessimists. With all these warnings from men whose business it is to study the question and who are fully qualified to advance an opinion, surely it is time that we took up seriously the question of afforestation.

It may be said by some that the timber of our foreign possessions will partly fill up the gap, but such is not the case. Indian timber, principally teak, is not in request to any appreciable extent while the great African forests are hardwoods, and as a rule unsuited to our wants. The forests of South America are on a par with those of India and Africa, while China and Japan, as also Australia, require more timber than they possess.

COST OF SUITABLE LAND FOR AFFORESTING.

When in the past the question of afforesting has been brought forward, the usual outcry has been that suitable land is too expensive to buy. But this argument will no longer suffice, for, as I have before pointed out, excellent land for the cultivation of high class timber can be procured in considerable quantity at about £2 per acre. Through the kindness of Lord Ancaster's estate agent, I have been allowed to look over the sale contracts of several parts of the Gwydyr Estate, in Carnarvonshire, and

from these I find that 7,412 acres were disposed of at an average price of £2 2s. 3d. per acre. The land was excellent for the production of timber, as the larch on other adjoining lands clearly pointed out. Again, the Crown recently purchased 12,500 acres in Scotland at the modest price of about £2 per acre. Other instances could be quoted, but the above suffice to show that land in every way suited for profitable tree planting can be bought at probably less than £2 per acre.

It is perhaps unfortunate that much of these waste lands are private property, the owners of which, even could they afford it, have little inclination to sink for a period of, say, twenty-five years the necessary capital required to be expended on the formation of plantations. But all this would be obviated by State ownership of the woodlands. The resources and continuity of a nation will always make the State the best custodian of forest property; indeed, only the State can readily acquire the necessary land on the most favourable terms and in sufficient quantity for the purpose of extensive afforestation. Private individuals, or, indeed, public bodies, labour under many disadvantages in this respect, not the least, as before stated, being the quarter of a century required before the money expended in planting can be even partially realised, while regularity of action and large wooded areas are first necessities to successful timber culture. It is therefore preferable in every way that the Government should take up the question of tree planting on a large scale, the necessary land being available at a moderate cost per acre.

COST OF FORMING PLANTATIONS.

This will vary greatly with the manner in which the work is carried out, the particular district of the country, nature of soil and rate of wages paid, as also whether fencing and drainage have to be engaged in. The difference in cost between "notch" and "pit" planting is very considerable, and the fact that the former method is almost exclusively adopted on the rough grounds throughout Scotland accounts mainly for the smaller first outlay on Scottish plantations. Thus at Grantown, Strathspey, the

Countess of Seafield's estate, Mr. Thomson, the very capable wood manager, has planted during the past 47 years 20,000 acres, at a cost, including fencing, of rather under £2 per acre. In England, however, where, for various reasons, pit planting is adopted, and larger plants are used, the cost varies from £5 to £6 per acre. For all practical purposes however, the cost of forming plantations may be put down at, say, £5 per acre, as the average of the following figures from various parts of the British Isles will show :—

	£	s.	d.
ENGLAND AND WALES.			
Yorkshire, at 600 ft. altitude, cost of planting and fencing per acre .	4	18	9
Kent, fencing and planting, per acre	6	3	0
Lincolnshire, fencing and planting per acre ..	8	0	0
Gloucestershire ,, ,, ,, ...	7	10	0
Carnarvonshire ,, ,, ,, ...	5	2	0
SCOTLAND.			
Invernesshire, Glengloy Estate, 800 ft. altitude, cost of fencing and planting per acre	3	10	0
Ross-shire, up to 1,200 ft. altitude, planting per acre . ..	2	10	0
Perthshire (planting only), per acre	2	10	0
Blair Athol, 3,665 acres, fencing and planting, per acre ...	2	10	0
Grantown, Strathspey ,, ,, ,, ...	2	0	0
IRELAND.			
Wicklow, 700—900 ft. altitude, fencing and planting per acre ..	4	13	11
Armagh (England) ,, ,, ,, ...	5	2	0

Another instance in Scotland may be recorded, in which 550 acres were planted at a cost of £1,178, or at the rate of £2 2*s.* 10*d.* per acre. This included, for fencing, £164 18*s.* 4*d.*; drainage £123 15*s.*; plants, £520 10*s.*; planting, £368 16*s.* 8*d.*

In connection with these figures, it may be assuring to state that in each case a strict account of the expenditure involved had been carefully noted, and the returns given are practically correct. The average cost, therefore, taking Great Britain as a whole, would be about £5 per acre for fencing and planting the ground. The above-named plantations, too, were formed on the very class of ground of which we have so much lying idle or bringing in only a few shillings rental per acre, in various parts of the country.

The Ross-shire plantation referred to was a bleak and barren moorland which the crofters, who used it as a common for their cattle and sheep, refused to rent at 1*s.* per acre per annum, while at Strathspey the 20,000 acres of land were let out previous to planting at 8*d.* per acre *per annum.* Vast tracts of the bare hillside of Wales are only bringing in a few shillings of rental per acre. It should be remembered that all the above-named plantations were formed on bleak, exposed moorlands—the very class of waste lands that I have so strongly advocated as the woodlands of the future, and of which at the present time there are about 15,000,000 acres lying idle in various parts of the kingdom—and therefore the cost of planting may be considered as or about £5 per acre. This with £2 5*s.* for cost of purchase and 5*s.* for incidental expenses, would bring the initial total expenditure to £7 10*s.* per acre. Elsewhere I have suggested that 1,000,000 acres should be planted over a period of twenty-five years, at the rate of 40,000 acres per year, which would be an outlay of £300,000 annually—a small sum when compared with the £25,000,000 expended each year by this country on supplies brought from abroad.

But there is another point that I should like to touch on whilst dealing with the formation of plantations, and that is that the work should only be entrusted to the efficient and practical wood manager, who is fully conversant with the whole routine of woodland work. It is frequently urged that forestry does not pay, but where such is the case it is always traceable to injudicious planting and wrong methods of management. No more can we expect the gardener, game-keeper, estate joiner, or even land agent to undertake economical timber culture than we could expect the forester to carry out successfully the duties of any of these individuals. Wrongly formed plantations are, unfortunately, far too common, in so far, at least, as adaptation of soil and trees are concerned, the results being that, financially speaking, the woods are a failure and proprietors, in consequence, fight shy of further planting operations. Not once, but over and over again have I examined and reported on such woods in various parts of the country, one of the most noticeable being in Nottinghamshire, where a large area of

ground was planted with oak for the successful culture of which the soil was quite unsuited, the result being that in sixty years the average cubic content of each tree was only a shade over 10ft. In another instance a gravelly area was planted with larch, the result being that the whole of the trees were pumped or rotten at the core. But many instances of a similar kind could be quoted. When pressing home the question of the extension of plantations, I have more than once been confronted by the statement that past experience does not warrant further expenditure in that way. That such is true cannot be denied, in many instances at least, but, then, as above stated, faulty methods of management are alone responsible for the failure.

FINANCIAL RETURNS FROM TREE PLANTING.

Though it must be admitted that, in the majority of cases at least, the financial return cannot be accepted as strictly correct (in most cases they are too low), owing to the woods being treated for other than commercial purposes, yet in not a few instances, where neither game rearing nor ornamental effect have to be considered, the yield of timber and gross returns for a stated number of years are perfectly reliable. Of course, where for game covert and underwood, or where the perfect development of the trees, as in ornamental plantations, are matters of first importance, and require that the individual specimens be grown thinly on the ground, the greatest yield of the best quality of timber cannot be expected, but where, as on various Scottish and English estates, the trees are grown thickly together and solely for their economic value, the case is quite different, and the returns of such will now be recorded.

One hundred acres of common land were planted from 1852 to 1867. Larch was the principal crop, with a few beech, Scotch pine, spruce, and silver fir. The plantation was thinned at intervals from 1871 to 1884, the thinnings being sold for close on £500, but many trees were used for fencing and estate purposes generally. The whole plantation was felled in 1907, and realised fully £4,500, or at the rate of £45 per acre. The larch on the lower portion averages 23¼ ft per tree, but on the exposed ground they were

only about one-third of that dimension. This plantation has a northern aspect, and is situated at from 800 ft. to 1,300 ft. above sea level. After allowing for the cost of planting and interest of money expended, the annual return per acre comes to about 20*s*. The adjoining heath covered land lets for about 2*s*. 6*d*. per acre. Again, on the Countess of Seafield's estates, Scotland, on grazing land which formerly brought in 8*d*. per acre, Mr. Thomson, the woods manager tells me that, at forty-seven years old, Scotch fir realised £40 per acre; while in another wood the individual trees brought 24*s*. 6*d*. each.

A larch plantation of 208 acres, on a steep hillside, was felled at the age of fifty years. The actual returns during that period were from thinnings, £4,500, from final felling, £14,500; or fully £90 per acre. The original cost of planting was under £5 per acre, and the value of the land at thirty years' purchase £7 10*s*. per acre, thus leaving a balance of fully £78 per acre at the age of 50 years.

The extensive hillside plantations formed by the late Lord Powerscourt in Ireland, those of Glendalough in the same country, by the Duke of Atholl between Dunkeld and Blair Atholl, at Glengoy, in Aberdeenshire, at Strathkyle in Ross-shire, at Gwydyr and Penrhyn Castle in the Principality of Wales—all of which were formed over thirty-five years ago, and the cost of formation and mangement strictly kept—are surely sufficient evidence not only of the profitable returns from woodlands, but of the feasibility of afforesting mountain land and the vast benefits that have been secured in the way of shelter to the dreary, treeless and bleak exposed uplands where the planting has been carried out. As far as actual profits are concerned, it will be prudent to assume that for the first twenty years no return whatever will be derived from hillside plantations, the thinnings up to that time doing little more than covering the expense of cutting and interest on first cost. For twenty five to forty years an annual return of fully 12*s*. per acre has in many instances been forthcoming, while the value of the standing crop at that age has been found to vary from £50 to £70 per acre. I do not think that these figures would be

generally speaking, too high, as at Balfour, in Scotland, the larch at forty-three years' growth on a hillside were valued at 20*s.* each, while a valuation of 21*s.* per tree was made of larch on the slopes of the Snowdon range of hills, in Wales, at the age of forty years But many similar instances could be recorded, and are constantly coming before those who have to do with the valuing and felling of timber.

Mr. Lewis Miller, who has probably had a larger experience of home woods than any other person, has given me some valuable and interesting information regarding what he has paid per acre for larch in various parts of Scotland. In twenty years, between 1870 and 1890, Mr. Miller has cut down growing timber to the value of over £250,000. A great many of the plantations were fifty years old, and yielded over £50 per acre when finally cut down, apart from the value of the thinnings taken out of them previous to the time they were cut down. To one proprietor in Aberdeenshire he paid £80,000 for plantations about fifty years of age, and the price worked out on an average at fully £50 per acre. One particular plantation of larch in Aberdeenshire, about seventy years old, yielded £150 per acre; another plantation, all larch, about forty-four years of age gave over £100 per acre, and these plantations were for the most part growing on what was formerly pasture or waste land, and which cost for planting and fencing from £2 to £2 10*s.* per acre. It will be needless to multiply cases in which poor lands worth only from 1*s.* to 3*s.* per acre have been made to realise by judicious tree-planting as much as 20*s.* per acre for fifty or sixty years with a final crop worth from £50 to £75 per acre. All the plantations above referred to are excellent object-lessons of the possibilities of the British Isles for the production of high-class timber and of what British woods can yield if properly planted and managed.—(*Timber Trades Journal.*)

(*To be continued*).

ORIGINAL ARTICLES.

NOTES ON THE FORESTS OF NORTHERN INDIA AND BURMA

BY BARRINGTON MOORE, M.F.

(Continued from page 219)

IV.—GRAZING.

The importance of this problem in the Deodar and the Sal Forests can hardly be over-estimated. In the Chir region it is of less importance because animals seldom brouse on the Pine, and a certain amount of grazing seems to be beneficial in reducing the length of the grass which occurs under the pine and thus aiding reproduction. In the first two regions grazing, if allowed to continue at its present rate, virtually means the gradual destruction of a portion of the forest. It is a difficult problem on account of the antagonism which a firm handling of it would create. It should, however, be faced for the future good of those very people whom it is now feared to antagonize. At present the Hindu, on account of his religion, practices absolutely no selection whatever in breeding cattle, but keeps everything, and turns out into the forest large numbers of poor, miserable, useless animals. The result is that where free grazing in a forest is to be had, the breed of cattle degenerates till they become practically worthless. A solution of the problem would be to allow a certain number of cattle free grazing (so many *per capita* for agricultural and domestic purposes) and to charge prohibitive fees for the rest. The fees would have to be increased gradually at first so as to avoid hardship, but could eventually be raised till it would not be worth a man's while to keep inferior animals. This would not only save the forest, but would also tend to improve the breed of cattle by making the native practise a kind of selection. Thus, the benefit to the native would be direct, as well as indirect, through the forest on which his future welfare depends.

V.—BURMA.

The most important need in Burma seemed to be the working up of a market for the numerous species producing excellent wood for various purposes, yet at present unsaleable because unknown. Another point is to devise methods of extracting the heavier woods, which are valuable but cannot be used because unfloatable. The latter can be done by building permanent roads or small guage railroads. Though expensive, it is to be hoped that this will be undertaken as the forests become more developed.

The present methods of management on the selection system seems the only practicable one till the inferior species with which teak grows can be utilized, and till more data has been collected on the growth and silvicultural requirements of teak.

The question of fire protection on certain types of teak bearing forest presents an intensely interesting problem. So far as could be observed, the teak growing with other species above Tinwa or Kyathung Bamboo in *protected* forest has very little chance of reproducing itself. On the same type in unreserved (unclassed) forest *not protected from fire* there was a large proportion of teak, often being found in pure groups, with excellent reproduction. A good deal is being done towards studying this problem, and undoubtedly it will soon be satisfactorily solved.

VI.—TRAINING.

As every one probably knows there are rumours of proposals to give the men entering the Imperial Service, at least a part of their training in India, instead of giving them all of it in England and on the Continent of Europe. Since all of the men in the Imperial Service have been trained either in England, or, in the case of the senior members at Nancy in France, it is natural that they should be prejudiced in favor of the European education. To the unprejudiced outsider, the case seems a clear one in favor of having at least part of the training in India.

One of the main objections is that few would go into the service, if they had to come out to India two or three years earlier to be trained. This could easily be overcome by counting a man's

service toward pension when he first came out, and even beginning his salary then, if need be. The Government would not lose very much by this, because for the first few years after a man has come out he has to be attached to a Division as an assistant to learn how things are done, and is of very little use to his Divisional Officer till he has learned the language and gotten to understand the different conditions in India.

The weightiest objection is that if a man came out at twenty-one, the same age at which he does now, to begin his training and failed to get into the service, he would be left at the age of twenty-three or twenty four stranded high and dry without a chance to get into any other service. Under these conditions, it is argued, few would come out. And if, to obviate this objection, they were to guarantee the probationers before sending them out, there would be little inducement for them to do any work during their training because they would be sure of their position without working. The answer to this would be carefully pick the men before sending them out, and partially guarantee them so as to be able to throw out any one who showed slackness. In this way the service would get only such men as have a keenness for the kind of life, and an ability for the kind of work, required of a Forest Officer.

Another objection is that a course at Dehra Dun would not do for the the men who were to serve in Burma The remedy for this would be to give all probationers a part of their field training in Burma. In this way every Imperial Forest Officer would have a good practical knowledge of conditions in Burma, and be better fitted to serve in either place, than any men with the present European training. As conditions are now, a man who has served only in India knows nothing of Burma, and the man who has served only in Burma knows nothing of India. This brings up one of the chief advantages of the training in India as compared with that in England, which is that the men could be given field work and trips in all the important forest regions of India and Burma, and thus be enabled to acquire a thorough working knowledge of conditions in the country as a whole. At present a man knows only the conditions in the one region in which he is stationed,

and has to learn those of every new region to which he is sent by slow and painful experience. The increased efficiency of a man, even if employed in only one region, who knows the other regions is obvious.

One of the objections on which some of the opponents of education in India lay most stress, is that there are no forests out here like those on the Continent of Europe which have been managed for a long while, and can show in actual operation the systems toward which all forestry should strive. No one would think of giving up all training in the French and German forests. But when the *principles* on which those systems are based have once been mastered, a trip of a few months would be sufficient to get an idea of how these principles are applied. Because, after all the *principles* are the important thing, *not the systems.* The systems may be modified, in fact they must be in India, to meet the different conditions, but the principles remain the same.

It must be admitted that the allied sciences, such as chemistry, mathematics, botany, engineering, etc., could be better taught at a University in England. This brings up the old discussion between the Forest School in a University (as in Munich), and the Forest Academy situated in a forest region not near a University (as Tharandt and Eberswalde). Broadly speaking, the one in the University gives the better theoretical training, the one in the forest the better practical training. The ideal is neither one nor the other, but a combination of both. The theoretical training is essential as a foundation on which to build the practical training, and to give a broad view of the ultimate aims of the profession. Therefore, it would seem best to give the theoretical training at a University in England, and the practical training in India. A suggestion would be that the course should be made a post-graduate one, that is requiring a University degree before being entered upon, as it is in all the other professions such as Law and Medicine, and in the most important Forest School in America. The advantage is that men's minds are more mature and they are more able to absorb the training given them, besides getting a broader view of what they are aiming for.

The final advantage of the training in India, and not the least important, is that the men could be sent out into the forest to make silvicultural studies on their own account. Thus, they would be taught the all-important *power of observation* and of *investigating things independently*, which is one of the most important requirements of a forester, and which is impossible in the cut and dried forests of Europe where there is neither opportunity nor incentive to discover anything new.

VII.—ORGANIZATION.

It may seem rather presumptive for an outsider to criticize so well-organized a Department as the Indian Forest Department, but there are three points about it which strike the observer as worthy of comment. The first is that the system tends to decentralization. There appears to be little common interest or attempt at co-operation between the different circles. This was evidently the original aim of the system. Whether it is beneficial or not remains for those in the Department to decide. Secondly, there is no machinery for specialization in the different branches of forestry, such as Working-Plans, Silviculture (*i.e.*, studies of important trees), Utilization of Forest Products, Forest Extension (*i.e.*, planting or artificial reproduction), *etc.*, Each Forest Officer is supposed to do a little research along these different lines on his own account. The impossibility of their having any time for such investigation must be evident to any one who has seen the amount of work forced upon each man. Hence progress is hindered. An important step towards improving this condition was made a couple of years ago when the Research Institute was started at Dehra Dun. Excellent work is now being done by the members of this Institute, especially considering the difficulties under which they have been forced to work and great progress along all lines may confidently be expected as the result of their efforts. Later on, if it is desired to divide the Forest Department into specialized branches, the Research Institute can very well be made the nucleus of these branches. The third striking feature is that every one in the Imperial Service is over-burdened with office work. The

result is that the field work, which is after all the important part of a forester's duty, sometimes has to suffer.

Considering all these difficulties, it is really inspiring to see the keenness which every man shows for his work, and the remarkable results accomplished. The Indian Forest Department richly deserves the enviable reputation which it has all over the world especially in America, for the excellence of its men and the efficiency of its work.

THE ENQUIRY INTO THE INFLUENCE OF FORESTS ON THE AMOUNT AND THE DISTRIBUTION OF RAINFALL IN INDIA

We have recently had occasion to peruse the papers relating to an enquiry being held in the Central Provinces on the above most important but complex subject, and the very pertinent question at once naturally presents itself: "What are the proper lines such an enquiry should take?" We may first glance at those of the preliminary enquiry and their results: these were somewhat hurriedly formulated and consequently we may reasonably expect something better in the further replies now awaited, since there has been more time in which to make enquiries, to record observations, and to make deductions. But one cannot resist the feeling that the lines of enquiry are not in the right direction For instance, more than one officer records well water-levels taken at various points within and outside the forest. It is difficult to imagine what results of any value it was expected to obtain by such measurements, since there are so many factors to influence such levels, such as soil, configuration of the ground, nature of the underlying rock, and various subterranean and geological phenomena that must necessarily have far more effect on the water-level in a well than that from forest growing around—not to mention the amount of water withdrawn daily which may vary considerably in the cases under comparison. Even assuming these disturbing factors to be absent, it is, we believe, a well proved fact that the water table level in forests is usually slightly lower than

that outside a forest area. The importance of forest growth in this direction is that it acts beneficiently in retaining the water table for a longer period at a constant depth, or at a less variable depth, rather than of directly increasing its level in the first instance.

The principal points on which the Government of India require information are as follows:—

(1) Is there any reason to believe that during the last half century the amount and distribution of the rainfall over large tracts of country has altered permanently for the better or for the worse?

(2) Has there been any permanent change in the level of the underground water-table?

(3) Has the flow of rivers and streams become less equable than before, that is, are floods now shorter in duration and more violent and destructive, and do the streams dry up more quickly in the dry season? and has this resulted in serious injury to the interests of cultivation or to other interests?

(4) Where such a change has taken place, is there any reason to connect it with the destruction of forest vegetation in the catchment areas of the rivers and streams?

(5) What evidence is there that the catchment areas have been denuded to any serious extent during the last half century?

In respect of (1) reports show that among the people there prevails a general idea that the rainfall is less than it used to be, but as one officer sapiently remarks they are probably biassed by the one or two extraordinary failures of recent years which are present on their memories. In one district the disappearance of lac from forest areas is held by the people to denote a diminution in the rainfall. This is hardly conclusive, since other unfavourable climatic reasons, and the noted variability of lac and its susceptibility to various climatic factors, besides the hand of man, and the rise in price of lac, would be quite sufficient in themselves to account for its disappearance.

Another officer notes that the change in the distribution of the rainfall appears to be at least as serious as the diminution in its amount, and adds that the people complain that they get scanty rain during the months when it is wanted, and copious but untimely showers when these are useless to the crops. His remarks refer to a practically forestless plain of roughly 400 square miles bounded only on the north and east by wooded strips. Another officer states that rain-gauge readings *in adjoining forest areas* show such large differences that the influence of other more powerful factors appears to render any deductions valueless.

Yet another officer with 30 years' experience of the Central Provinces notes that it is only in recent years that changes in the annual rainfall and monsoon periods have been noticeable, and considers that atmospheric action and the snowfall and temperature in the Himalayan regions probably have a far more marked influence on the monsoon bearing currents than the existing or denuded forest areas, and expresses it as his belief that there has been no permanent diminution on the amount or distribution of rainfall over large tracts.

Does this not bring us to the point arrived at long ago by continental experts that forest areas do not appreciably affect the *amount* of rainfall but only the *distribution*, and if this is true in the variable climate of Europe, how much more true is it likely to be in the case of the regular Indian monsoon conditions and currents with the enormous driving forces behind them.

Also why should the matter be considered of such great importance since the effect one way or other is bound to be very small and for all practical irrigation or agricultural purposes negligible, and it is mainly with this aspect of the case that we are concerned.

Surely the true metier of the forests in this respect is in danger of being overlooked, *i.e.*, that of giving a better distribution of rainfall, and a more equable and sustained drainage zone and storage.

Any Revenue Officer will tell you that a comparatively small rainfall will suffice for the growing of Indian crops, provided only it

is well distributed. Thus according to circumstances from 25 to 50 inches is ample and a difference in average totals of several inches whether in excess or deficit may and probably will not affect the crops one way or other, or quite possibly in inverse ratio to what one would expect from the figures.

We would therefore suggest that the lines for enquiry on this point, at least in these Provinces, would be to try and discover whether there has occurred any difference in the number of days on which rain has fallen in the year, and more especially at periods of importance to the crops than to try and find out reasons for comparatively small aggregate differences. We would omit all comparison of figures of real monsoon rainfall since the influence of the main monsoon currents must necessarily far outweigh that of forests, but would pay special attention to the dates of commencement and completion of the rains, and to the amount of rainfall during the period directly preceding the arrival of the main monsoon, and similarly during the period *directly* succeeding the retirement of the main currents.

It is noteworthy that in the enormous hilly and wooded areas of the writer's division rain falls almost monthly, which is, we should think, almost unprecedented in the Central Provinces, and the rich black-cotton plains lying between the forests and hills reap the full benefit of this most unusual phenomenon, and as a result grow some of the best wheat in the Provinces. It is quite possible that the forests in conjunction with the hills have something to do with this.

We do not profess to be agriculturists, but, subject to correction, we believe that omitting the main monsoon rainfall the two most important periods for light rainfall are the first fortnight in October and the first half of February. The former is of importance because it is not only the final rain required to mature the *kharif* (rice and millets) crops, but it enables the ground to be partially ploughed for the *rabi* (wheat and gram) crops, the latter *vice versâ*. Rain at these two periods then fulfils a double function and hence it must be of the greatest importance. About 3 inches of rain in October and 1 inch to 1½ inch in February will suffice,

and it is just here that we maintain we should reasonably look for the maximum effects of forest on the rain fall, since there is no question of monsoon currents, and consequently it should be easier to gauge the exact importance of forests at these times.

It is then in these two directions that we believe figures of value might be obtained, and not inconclusive and we fear vain attempts to account for average differences of total rainfall, and we think nobody will deny that the most favourable results will be obtainable from rainfall figures between monsoon and monsoon, since the monsoon currents being eliminated, the full influence and effect of hills and forests must make themselves felt if at all. Again rain early in May is of great use for ploughing for the *kharif* crops as it not only lessens the labour but increases the fertilising properties of the soil by infiltration of light and sun, so that the soil becomes well aerated previous to sowing. Scientific agricultural experts would probably say it helped the formation of nitrate bacteria. In September also, some four falls of rain of about 2 inches each time will do the maximum of good, and the main currents having by then slacked off, it is quite possible that forests may begin to exercise a salutary effect. Similarly in the development of the *rabi* crops a fall of about 1 inch is, we believe, of very great importance when the wheat is perhaps 6 inches high, that is generally towards the end of December. Consequently we suggest and believe that careful comparisons of rainfall figures in February, early half of May, September, October, and December are far more likely to produce results, if any exist, than any scrutiny of rainfall figures for the whole year.

It might also yield valuable results to compare the outturn of crops on soils of as nearly as possible equal soil values in the middle of big treeless plains and on the edge of or in adjacent forest areas, if possible and where necessary eliminating or allowing for damage by wild animals in the latter case. Also indirect evidence of value might be obtainable from villagers' estimates of the average cropping results of any given selected area, *i.e.*, whether the amount of the crop had appreciably decreased or increased within memory.

But we confess we do not hold great hopes that any rainfall comparisons will yield data to any great value, or will lead to any definite conclusions one way or other; judging from the somewhat negative and conflicting results obtained after many years on the continent. We would trust to thermometers rather than to rain-gauges to show us the real beneficient effect of forests, since such readings are definite and unaffected by outside disturbing factors, and one can make certain deductions from any definite results arrived at.

Proceeding to point (2), whether there has been any permanent change in the underground water-table level, there seems to be a general consensus of opinion that this level has sunk of recent years, but there is no unanimity in attributing this in outside areas to the absence of forests.

In Berar, indeed, one officer notes that the level has sunk simultaneously in the forest as in the outside areas.

No dependence can be placed on well data since greater consumption in recent years with the growing demands of increased population, and the falling in or silting up of wells would of themselves account for apparent lower water level in wells or for their drying up more quickly: while the short rainfall of late years would also be a contributory cause.

One officer quotes a suggestion made by the people themselves to explain this sinking in water level that is worth mention, and is a good example of how simple commonsense and instinct arrive at the truths which evade more subtle and scientific minds. The reason they attributed was the extent to which land has gone out of cultivation during the last 15 years in the locality in question, and the natural result of which was that the rain which used to sink into the soft earth of the ploughed fields now runs off the hard baked surface of the bare land, and is carried away by river drainage systems and is lost to the district. We have only been reading today the précis of a lecture given by Mr. Sidney Preston, a well known agricultural and irrigation expert at Ajmere College, in which he lays particular stress on the immense importance of banking fields so as to prevent the rain running to waste in the

river drainage systems, and to retain it until it has time to be absorbed into the ground and so serve as an enormous storage underground reservoir to feed wells and irrigation works. The two are in fact only modifications of the same great truth. A case in point has recently been given to the writer where by banking "burra" land the people are able to get double crops off the area. Some well measurements recorded which showed that the average water level in well wooded tracts was higher than in forestless tracts by some 7 feet can hardly be considered as conclusive evidence of the effect of forests unless the configuration of the ground in each case is taken into consideration as well as the soil, and this *is done does not appear. One reason why well levels in wooded* tracts will be higher than in outside areas is because the cultivated areas are usually comparatively if not quite flat, and therefore water would lie at a low level, while wooded tracts are more often than not associated with hills, and thus the configuration of the ground plays an important role.

Again, in the case of agricultural villages the site of a well to be of any use must be close to the village, and in all probability the latter is more often than not an unfavourable place for sinking a well, and consequently water is only tapped at a lower level.

As another officer points out it is very common when enquiries are made as to why villages were deserted 30 years ago to be told that it was due to the difficulty of water supply.

A case is quoted also of a very well wooded area but situated at a high elevation where a general annual exodus has to be made to the lower lying country in the hot weather months owing to the scarcity of water for men and cattle. This is almost certainly due to the rock or subsoil formation we should say.

We may take it then that well measurements are not at all to be depended on for accurate deductions. At the same time any one acquainted with the laws of water subsoil storage and its guiding principles will hardly deem it worth while to argue that forest growth does not have a beneficient effect in this direction, and a far from inappreciable influence too, since it constitutes natural field embankments so to speak.

It might perhaps be possible to obtain information of some value by completely denuding selected well-wooded areas, after "recorded" water levels for a few years, and to see then whether subsequent readings showed any appreciable difference. It would, however, be necessary to determine as far as possible the area of the well's drainage cone so as to clear this thoroughly. This should be able to be gauged roughly by emptying the well and estimating the drainage area approximately corresponding to the volume at well water level for the kind of soil in which the well was sunk. A homogeneous soil throughout should, if possible, be selected. These data might perhaps be obtained by trial borings at different points round the experimental well, and at varying distances from it, with a view to see if the water level in the surrounding ground sank in sympathy with the lowering of the water level in the main well, or reflected its ups and downs.

Similarly, too, on wooded areas an experiment might be tried to see whether continued permanent lowering of the well water level affected the growth of any of the trees standing close by, since the emptying of a well and any consequent draining of its drainage cone might be held to be analogous to the gradual natural draining of areas that must go on all through the year, except in the rains, and more particularly in the hot weather months, by underground percolation into perennial streams.

Finally, we are of opinion that the only valuable data that can be hoped to be obtained from well-level readings would be by simultaneous readings at intervals throughout the year from experimental wells in wooded and forestless tracts respectively that would show not a comparison between their respective water levels but between the rates of sinkage of levels in each case. To be of real value of course no water should be drawn from them, or else if drawn should be drawn in fixed and known quantities. It is as we have already said first in distributing more equitably and in storing the water that forests play their most important part, and then in maintaining the underground water at a more constant level, and therefore it should be our endeavour to test and measure the effect of these known phenomena rather than to try and prove the

existence of other phenomena which probably do not exist. To test the storage capacity of wooded, as compared to forestless, areas, rain-gauge readings might be taken for a few years at a selected site, and the well level variations then carefully recorded, and subsequently when the area was cut over similar comparative readings would be taken to determine whether any appreciable lowering in water level resulted. The rain gauge readings would not be to see whether there was more or less rainfall, but to be able to make allowances in the storage capacity according to the actual rainfall if necessary.

The next point is the flow of rivers and streams. Here the opinion seems to be that it is doubtful whether the flow of streams and rivers in times of flood are less equable than heretofore, but there is a good deal of direct circumstantial evidence to show that in many places streams dry up earlier now than they used to, or else dry up when they used not to, but the somewhat hurried investigations did not not give time to discover whether there had been any denudation of forest in the catchment area of such streams since or within a few years of this being remarked.

There are also numerous cases cited of streams now containing water that did not do so previously, and these cases are nearly always in fire protected areas, and are attributed mainly to this cause which is probably a correct deduction.

In one or two cases officers have noted apparent anachronisms, such as streams drying up or ceasing to flow, of which the catchment areas are in wooded tracts, and *vice versa*, but one cannot attach any importance to these cases until one knows through what sort of rock and sub-soil they flow. Thus the Narbada is cited as rising in wooded areas and flowing throughout the year in spite of its passing near its source through an almost completely treeless tract, whereas the Banjar goes into pools though well wooded along most of its length. But the Narbada in the open country runs through rock and hard laterite subsoil mostly while the Banjar flows through schistose gneissic rocks so that this result is hardly to be wondered at. There are also one or two instances cited of streams rising in denuded tracts that

run dry in the course of the year, but their value as examples is somewhat vitiated and rendered negative by the fact that it is not stated whether or no they have always done so in the memory of man, or have only done so of recent years. There are also several instances of streams that contained water in pools or flowing throughout the year formerly and which dry up now, and whose catchment areas are mostly in Government forests, and in respect of these it is noted that, while there is proof of heavy overcutting in such areas previous to reservation, their drying up does not date anterior to reservation but subsequently. This may be due either to the previous overcutting and general denudation of forest growth only taking effect after some years, in which case in course of time they should resume their flow, or else some of their drainage area is being tapped by tanks, or their feeders are on the surface largely or they are mainly the result of surface run-off and are not fed by subterranean percolating streams, and the forest growth is now acting as a counter-drainage system, only that in that case it must be storing up its water while the stream was carrying it away probably to waste.

In this connection it should be remembered that except for canals which at present do not exist in the Central Provinces, and probably also never will to any great extent, flowing water is rather a bad thing than otherwise, because it is all, or nearly all, flowing to waste, and this wastage represents a general drainage of the distributed and stored moisture throughout the localities forming the main and auxiliary catchment areas of each river system and its tributaries, and this loss cannot but have a bad effect though it may not always be sufficient to be appreciable. The main irrigation and water storage in the Central Provinces being by means of tanks, small and large, every cubic foot of water that runs to waste in the streams and rivers may be and often is depriving a tank or well of some of its supply: consequently it is not understood why we should like to have streams and rivers flowing all the year round. Even where this waste water would remain unutilisable if not tapped and taken off by streams and rivers it would perform two most important functions, *i.e.*, it serves

to keep the water-level table higher, so that tanks will fill more rapidly in the following year, and by keeping the subsoil moist and feeding tree growth, it returns itself in enormous quantities through the transpiration of leaves that is always going on, and so renders the air both cooler or more saturated, so that a more equitable temperature prevails, and rain is more likely to be drawn from clouds that cross high-wooded hills anywhere.

It is often remarkable and apparent without any need of a thermometer the noticeable difference of temperature in the hot weather inside and outside forests, and this is due mainly to the perpetual transpiration of moisture going on.

One point does not seem to have been touched upon and that is the very often considerable erosion resulting in black cotton areas from the denudation of forest growth on undulating and hilly ground. The writer has within the last fortnight seen many acres of culturable land rendered useless, and since these 'cuts' are continually multiplying and increasing in dimensions it is quite possible, unless steps are taken to stop it, in time the acreage thrown out of cultivation may amount to hundreds and even thousands of acres. At present there is plenty and to spare, as the population is scanty and the area large, but it may not always be so, and it is as well to be fore-warned and fore-armed. Also much water will eventually run to waste that should fertilise the land. In respect to point (5) there is a general opinion that in these Provinces at any rate no great denudation of catchment areas has occurred in the last 50 years, whatever happened prior to that. We could suggest if there are any irrigation figures available of flow of rivers and if it is possible to calculate from these the percentage of outflow to the sea of total rainfall or of total surface flow or run-off, that possibly very valuable results might be obtained from a comparison with such figures if available for some 10 15 years ago with figures now. This might show far more accurately and with far more certainty whether the drainage flow of river systems has increased or not.

If it can be shown to be so, this would obviously at once account for lower water-table levels, and so on, and if such figures

are not available we would venture to suggest that such figures which can be fairly accurately obtained should be compiled by trial for all main river systems for fixed periods in the year.

It seems to us that this would give figures which would refer to enormous catchment areas in a very comparatively simple and easy way, and where appreciable changes came to light, these experiments would be applied higher and higher up, until finally the locality most concerned could be discovered.

Possibly irrigation officers will declare it to be impracticable, but after all these sorts of readings are common in preparing bridge estimates, and only required to be multiplied, and if feasible they would do away largely with the necessity for elaborate experiments in other directions which owing to the numerous outside factors and side issues and influences, can at best give most indefinite results if indeed results of any real value at all.

Our main object in writing the above article is to try and start a discussion, to obtain an idea of what is happening in other Provinces in the way of elucidating like phenomena, as ideas from outside are always of value, and there can be no question of the supreme importance of the matter.

MORE LIGHT.

REVIEWS AND TRANSLATIONS.

FOREST FLORA OF THE BERAR CIRCLE.*

BY D. O. WITT, I.F.S.

Officers of the Central Provinces are to be congratulated on the prompt way in which they are giving effect to the proposals put forward at a conference of Forest Officers at Jabalpur in 1905, for the preparation of pocket lists of the principal trees, shrubs and climbers in their respective circles. The second of these lists, that for the Berar Circle has now appeared, and only the Southern Circle remains to be dealt with. The Berar list, which indeed somewhat exceeds the connotation of its title, is in many respects an improvement on its predecessor and may, for the present, be taken as a model for subsequent lists. As explained in the Introduction it is intended to be a companion to the 'the List of Trees of the Nimar (evidently a slip for Northern) Forest Circle, but that it differs in including brief descriptions of the species, herbaceous plants of economic importance and against the name of each species, the divisions from which it has been reported'. In addition it may be said that the list seems more complete than that of the Northern Forest Circle. Assuming both lists to be complete, and omitting the herbs and cultivated trees and several small undershrubs such as *Barleria Prionitis*, *Ruellia patula* and insignificant climbers like *Rhynchosia minima*, the Berar Circle would contain some 60 species that are not found in the Northern Circle, while the Northern Circle only contains 27 species not found in the Berar Circle. This is not only improbable on general grounds, but it is almost certain that many of the Berar species have yet to be added to the list for the Northern Circle, among which may be mentioned, for example, *Sterculia colorata*, *Spondias mangifera*, *Combretum decandrum*, *Dregea volubilis*, *Pergularia pallida*, *Rhabdia lycioides*, *Colbrookia oppositifolia*, *Litsæa polyantha*, *Antidesma Ghæsembilla*, *Ficus retusa* and *Ficus Cunia*. On the other hand the Berar

* Published at the Central Provinces Secretariat Press, Nagpur.

list includes one or two doubtful species (*e.g.*, *Embelia Ribes*) and probably itself as yet lays no claims to completeness Of widely distributed and common species *Wendlandia exserta*, which extends from the northern Konkan and Deccan through the Central Provinces into Bengal, is almost certainly likely to be found in Berar. *Dædalacanthus roseus* is mentioned but not *D. purpurascens*. *Clerodendron serratum* is included but not *C. infortunatum*. Is it a fact that this latter species is really not found in Berar? The brief descriptions attached to the names of the species are usually much to the point and in most cases sufficient to enable an officer to ascertain, after learning a vernacular name, whether he can connect with it the scientific name with which it is associated in the book. This, we take it, is the main use of brief diagnoses of species in lists where no family nor generic characters are given, and they should form a feature of all future lists. With regard to the vernacular names, which are of so much importance in short pocket floras, the language is only rarely quoted. The omission is to some extent remedied by giving the forest division in which the name is used, when the latter is merely local. It is noted that *kari* is *Miliusa velutina* in Berar, but *Saccopetalum tomentosum* in the Northern Circle, and that *Um* or *Hombu* is the name for *Saccopetalum* in Berar! *Kari* is a very widely distributed name for both but is believed to be more correctly applied to *Saccopetalum*. *Um Hombu*, *Om*, or *Ombe* is also applied to both but usually to the *Miliusa*. Both appear to be pre-aryan names The plant called *Gengarun* should be *Grewia Rothii*, *DC.* not *G. salvifolia*, Heyne, which is quite distinct. It is also an error to say that with this species may be classed *G. excelsa*, Vahl; an error arising from the confusion existing in the Flora of British India and in the Calcutta Herbarium with regard to these species. Under *Spatholobus Roxburghii* it is stated "Fls. bright red (Brandis says white but this must be a mistake)." Brandis makes no mistake in his assertion, on the contrary white (or rather cream) is probably the more usual colour of the two. The description of *Vitex leucoxylon* raises an old doubt. The author, with most other writers, describes it as a *large* tree. The F. B. I gives it as a *small*

tree, and it has been observed as a straggling shrub along rivers Is it possible that there are two species? The description of the *flowers* as being axillary is, of course, a slip for *inflorescence*. A few other slips may be referred to, *viz.*, the inclusion of *Embelia* under *Rubiaceæ*, the description of the *retinacula* in *Acanthaceæ* as *recurved* and the description of the leaves of *Colebrookia* as being always whirled The short glossary requires revision. An achene is said to be a form of indehiscent fruit, but although less technical words (globose, elliptic) are defined, there is no definition of dehiscent or indehiscent *Glaucous* is said to be "covered or whitened with a bloom," here *pruinose* is the more correct term. *Gynophore* is said to be the "stalk-like support of a carpel" not only should *carpel* read *ovary*, but neither carpel nor ovary are defined. There are several other definitions which require amendment There are, also, numerous printers' errors which appear inseparable from a technical work printed at a Government press. The economic notes are interesting and to the point Mr. Witt considers that the wood of the common *Boswellia serrata* has been much under-rated, and he says that most of the charcoal in the Melghat is made from it. It is to be hoped that Mr. Witt may one day find time to enlarge his present list to a Forest Flora of the Berar Circle, somewhat on the lines of the excellent Forest Flora of the School Circle.

H. H. H.

BIRDS OF THE PLAINS.*

BY DOUGLAS DEWAR, I.C.S., F.Z.S.

[*Contributed.*]

Under the above rather dull title is to be found a collection of entertaining sketches on the subject of bird life in the plains of India The author is evidently a keen observer of nature and a lover of birds. Nothing is too commonplace to merit his special attention, and writing as he does in a lively and attractive style he has produced a book of exceptional interest and one which must

* Published by John Lane Company. Price 10s 6d, net.

appeal to all with souls not dead to nature's charms. Among some of the interesting questions discussed by the author are the origin of parasitism in the koel, the reason for the resemblance between the Drongo cuckoo and the king crow, and a modification in the generally accepted theory of sexual selection.

In the case of the koel Mr. Dewar is inclined to shift the blame of parasitism on to the host, the common crow. The idea is an ingenious one and seems to offer a not improbable explanation of the facts. Whether guilty or not guilty, we are not likely to paint the crow too black. He is capable of any villainy.

The author is of opinion that the remarkable resemblance between the Drongo cuckoo and the king crow is an accidental one, and is not due to natural selection. He gives his reasons which are in some respects very plausible. His explanation however seems almost incredible, although, on the other hand, it is admittedly very difficult to see how incipient blackness could have materially assisted the cuckoo in deceiving the king crow. Such a remarkable similarity in shape and colour could, it is thought, only have been brought about by the process which results in what is not very aptly termed "mimicry." The orthodox theory of sexual selection, in which the male is chosen by the female mainly on account of his beauty, is rejected by our author who brings forward a good deal of evidence to show that the selection between the sexes is mutual and not a one-sided affair. Moreover, that vigour rather than beauty is the quality which is mainly appreciated. The book is illustrated with photographic reproductions, most of which are exceptionally good.

BAMBOO AS RAW MATERIAL.

This paper by W. Raitt, (*Paper-making*, 26 (1907), *Nos.* 11, *pp.* 502—508; 12, *pp.* 539–541) which originally appeared in *Paper Mill*, contains a general discussion as to the probable import ance of bamboo as a source of wood-pulp, together with notes on laboratory tests made by the author in the production of wood-pulp and observations on the growth and behaviour of bamboo under various systems of cropping, with estimates on the average weight of the material which might reasonably be expected annually from a given area under rational systems of culture.

The results of the author's experiments in the production of wood-pulp from bamboo indicate that the use of two or three year old growths appears to be the most economical and to differ very slightly in the results. It is concluded that cropping every third year, when the stems are from 28 to 34 months old, will secure an absolute permanence of growth. In making paper-pulp the nodes must be removed from the bamboo cane. Fifteen tons of canes per acre every third year is given as the dependable crop to be realised from poor to moderate bamboo stands. According to data secured from laboratory tests it is estimated that 5 tons of air-dry bamboo will produce at least 45 per cent. or 45 cwt. of unbleached pulp.—(*Experiment Station Record.*)

THE BREEDING OF PLANTS SUITABLE FOR GROWTH IN ALKALINE SOILS.

Investigations are at present being carried on by the United States Department of Agriculture with a view to producing plants resistant to drought and to alkaline soils, and the following is a brief abstract of some of the more important results published in Bulletin No. 113 of the Bureau of Plant Industry, entitled "The Comparative Tolerance of Various Plants for the Salts Common in Alkali Soils":—

The salts which exist in these soils are sodium carbonate and bicarbonate, with sodium and magnesium sulphate and chloride, all of which exert a more or less toxic action on crops grown on

soils containing them. Work on this subject is complicated by the fact that the soils hardly ever owe their alkalinity to any single salt, but to mixtures of the salts in proportions which vary according to the locality.

So far most of the experiments have been carried out with solutions of a single salt, but experiments are now in progress with (1) mixed salt solutions, (2) water extracts from natural alkaline soils, and (3) with alkaline soils themselves, and although it is obvious that the results obtained with solutions of a single salt are not directly comparable with the mixed salt solutions in the alkaline soils, it is necessary to first investigate the influence of each salt separately.

The seedlings of the followings plants, which are commonly grown on alkaline soils, have been experimented with—white lupin, alfalfa, maize, wheat, sorghum, oats, cotton, and beetroot, and it has been found that seedlings from old seed are much less resistant than those from fresh seed; while different genera and species and also different varieties, or even agricultural strains of the same species, vary very greatly in their power of resistance. This last observation seems to indicate the possibility of breeding plants suitable for cultivation on alkali soils by artificial selection.

With most of the plants experimented on, magnesium sulphate or chloride was the most, and sodium bicarbonate or chloride the least, toxic; with maize, however, the reverse is the case.

The addition of another salt, notably calcium sulphate, to the solution greatly decreases its toxicity; for example, the addition of an excess of calcium sulphate to magnesium sulphate renders the white lupin capable of resisting a solution containing forty times the naturally toxic amount of pure magnesium sulphate.

The results of these experiments should be of interest to cultivators in India and elsewhere, where large tracts of alkaline soils exist.—(*Bulletin of the Imperial Institute.*)

Photo-Mechl. Dept. Thomason College, Roorkee. Photo. by Barrington Moore.

The Grazing Problem, Garhwal Division.

A forest open to grazing.

VOLUME XXXV NUMBER 6 & 7

INDIAN FORESTER

JUNE & JULY, 1909.

THE DECENTRALIZATION OF INDIAN FORESTRY.

The Report of the Royal Commission on Decentralization in India forms a volume of 339 pages, and the evidence on which it is, to some extent, based is published in nine volumes, the whole outfit of 10 foolscap tomes costing the large sum of £1 2*s.* 6*d.* The complete works of many of the best authors can be acquired for a less sum in these days of pulp-paper and cheap printing and would probably be of more permanent interest to most of our readers. In the Report, forests are treated of in about nine pages which are filled chiefly with explanatory and statistical information, but they also receive mention under other headings, and individual Commissioners have recorded supplementary memoranda or footnotes in their regard. We have already given the summary of the conclusions arrived at on page 294 of the May number, but for convenience we repeat them below :—

"We emphasize the need for further decentralization in regard to forest administration and recommend that—

(*i*) the Inspector-General should cease to be a *de facto* Deputy Secretary to the Government of India and be simply an advisory and inspecting officer ;

(*ii*) the Governments of all major Provinces which possess a considerable forest staff, should be able to appoint their own Conservators (and Chief Conservators where these exist) as Madras and Bombay now do;

(*iii*) certain restrictions now imposed on Local Governments by the Forest Acts should be relaxed, and any important amendment of the forest law should be undertaken in the Provincial Legislative Councils;

(*iv*) if the Indian Forest Code is to be retained at all, it should only contain matters essential for Imperial control"

With regard to the first item the Commission devotes some 20 paragraphs to the consideration of the duties of Imperial Inspectors General, and concludes that they cannot be dispensed with. But it is, rightly, most strongly against the assumption of administrative power by these officers as being an inducement to Provincial Officers to look past their own Local Governments. In short, it considers that the duties of Imperial Inspectors General should be:—

(*i*) The charge of experiments and research and the supervision and co-ordination of subsidiary research in the Provinces.

(*ii*) The establishment of bureaux of information and the dissemination of useful information.

(*iii*) The furnishing of technical advice and information to the Government of India.

(*iv*) The furnishing of full and ready assistance to Provincial Governments, either in response to enquiries or on their own initiative.

(*v*) Inspection throughout India in all Provinces.

No one will be disposed to quarrel with this précis of the duties as applied to the Inspector General of Forests, it is rather with the detailed suggestions of procedure that some critical remarks may be made. There was evidently some difference of opinions amongst the witnesses as to whether the Inspector General of Forests should continue to advise regarding the

compilation of every Working Plan, but the Commission appears to have been impressed by the objection to "subordination" made by the Conservator in Bengal, and advises that in future the Inspector General of Forests should only be consulted in regard to Working Plans for specially large forests. Sir S. Edgerley, however, considers that largeness is not the proper criterion, and would leave all references at the option of the Local Governments concerned. The Inspector General of Forests, nevertheless, is to receive all Working Plans and may then offer remarks on them, even when he has not been consulted beforehand—a thankless task which he will perhaps be wise not to rashly undertake save in self-defence or he will find himself involved in endless disputation It is a matter for opinion whether the present system of ensuring, as far as possible, that a Working Plan is suitable *before* its issue is not superior to that suggested, which remits criticism to a time when the Plan has been issued or is in process of being carried out, and whether the abolition of a technical Head of a Department which this system would imply, will work efficiently in practice. At any rate the Commission's dictum that "the submission of Control Forms to the Inspector General of Forests is superfluous" shows a want of knowledge of the circumstances of the case, for, if the Inspector General of Forests is to be in charge of Research and to establish Bureaux of information, he will be debarred in future from carrying out his duties, as far as silviculture is concerned, if deprived of the information as to the results of Working Plans which are concisely set forth in the Control Forms, and which has afforded scope for valuable forest literature in the past.

The remission of that portion of the Inspector General of Forests' duties in the Imperial Secretariat which consists in noting on all cases which concern the Forest Department is held to be desirable, for the reason that the Inspector General of Forests can be more usefully employed in technical work than in the ordinary routine of administration, and because it is only in very exceptional cases that the highest technical and administrative qualifications are found united in the same person. With regard to the first objection the difficulty will be to draw the line between

cases requiring technical knowledge and others. Probably a very large proportion of the forest cases treated in the Imperial Secretariat involve either technical or departmental knowledge for suitable settlement, and in practice the result may be that the Superintendent of the Forest Branch of the Revenue and Agricultural Department will, in future, have considerable responsibility in their disposal, for though it is doubtful whether the work which, up till now has taken up much of the time of the Inspector General of Forests and his Assistant, can be transacted as suggested without additional assistance, yet even if a member of the I C S. is appointed to succeed the Inspector General of Forests in the charge of the Branch, he will scarcely remain there long enough to acquire complete familiarity with this special subject.

The next point is that the appointment of Chief and other Conservators should rest with the Local Government. The arguments for and against this step are too well known to our readers to necessitate repetition. Some of these arguments have become obsolete through the introduction of personal pay, and though the system works well in a service like the Public Works Department with a staff of 1,000 officers distributed over various branches of the engineering profession, it would appear to be open to grave doubt whether in a department of one-fifth of the size and with little specializing in practice the change, if introduced, will not lead to provincialism and its recognised drawbacks.

Next, the restrictions as regards the Forest Acts which are to be relaxed are in some instances no doubt beneficial. It is right that Local Governments should have power of deforestation subject to the control of the Government of India, and that areas not exceeding 200 acres need not be specially subject to such control; that rules for the management of village and protected forests, for the levy of duty, and for regulating the transit of forest produce should be made by Local Governments, and that previous sanction to such rules should only be necessary when Native States are liable to be affected by them; but it is a different matter when it is proposed that "serious amendments of existing Forest Acts" should be undertaken in Provincial Councils "so that each

Province may have a Forest Law suitable to its own conditions." For, firstly, the boundaries of Provinces are not unalterable, as has been proved in recent times in the N.-W. P. and Oudh and in Bengal and Assam, and secondly, a Forest Law should have its foundations on principles of Imperial policy, while having full scope to build up thereon rules suitable to Provincial local conditions, in fact the rules under the Act and not the Act itself should be local.

Lastly, as regards the Forest Code, it does not appear to have struck the Commissioners that the corrigenda with which the last edition already bristles, are in themselves proofs of changes of the past few years by which the Imperial Government has relaxed much of its control over Provincial Forestry, and that ultimately the whole of the Code Articles will have, without any special order, reference only to matters of Imperial control. It will suffice in this regard to glance at the alterations made in the matter of Forest Education to learn what the tendency in the way of decentralizations has been in the past, and the Commission agrees that the training of the Subordinate Branch of the service should be left to local Forest Schools. Turning now to the relations between Revenue and Forest Officers, we find that the Commission is of opinion that the position of Commissioners of Divisions is not very clearly understood. It thinks, as do we all, that Conservators of Forests should be subject to their control in all matters in which the operations of the department concern the public, but it appears to think also that this theory is not always practised, and it is hinted that in such sad circumstances it may be necessary to allot special functions in forest questions to Boards of Revenue and Financial Commissioners. Mr. Hichens, however, finds no reason to doubt satisfactory relations between Commissioners and Conservators and would let well alone—which is undoubtedly an extremely wise policy.

With regard to Collectors and District Forest Officers, the Commission considers that the existing position has worked satisfactorily, but in spite of this it insists on the complete subordination of the Forest Officer to the Revenue Officials, and touches on the

control of forest subordinate establishments by the latter. It considers that minor forests and pasture lands should be completely controlled by the Revenue Department. The Chairman and Mr. Hichens, however, are satisfied that relations between the two Departments are satisfactory, and that there is no necessity for increased control by the Revenue Officials. And in this the officers of both departments will probably agree, as neither wish to be hampered by interference in carrying out the work for which each is responsible.

Finally, in a supplementary memorandum, the Chairman writes that the absence of a Chief Conservator in Madras and Bombay cannot be considered adequate or satisfactory He objects to the head of a highly technical department being a member of the Board of Revenue or a territorial Commissioner, and considers that even if, in the absence of a Chief Conservator, frequent references were made to the Government of India on forest matters, such a system must lead to that interference with local control which is so strongly condemned by the Local Governments themselves. It is refreshing to find opinions held by many thoughtful Forest Officers confirmed by the Chairman of the Commission.

On the whole, none of the changes suggested by the Commissioners were unexpected by those who have followed their train of thought. That if these changes are to be brought about, the Department from a professional point of view, or the forests from an economic point of view will be the better for them,—time alone will show. But what seems certain is that the post of Inspector General of Forests will, in the future, not possess the same importance to Indian Forestry as in the past; that there will be no scope for the exceptional Officer who, in the words of the Report, possesses "the highest administrative and technical qualifications." On the other hand, while there will be no work for his Assistant, the Inspector General himself will have ample leisure to extend research, to establish Bureaux of information and for inspection; his office thus should become the centre of Scientific Forestry for India, and it is even conceivable that in the future, when the

Department is fully organised, his influence may be as fully felt as in present conditions, when there exist such excellent opportunities for bringing to notice the requirements of both Imperial and Provincial forestry But this desirable state of affairs can only be attained through the continuous co-operation of all officers of a department which will, in the future, only be Imperial in its recruitment and which will have become Provincial as regards it work and ambitions.

SCIENTIFIC PAPERS.

AFFORESTING WASTE LANDS AND THE FINANCIAL RETURNS THEREFROM.

BY A. D. WEBSTER.

(Continued.)

ADVANTAGES OF TREE PLANTING.

But not only from a strictly financial point of view but, in a hygienic sense, for shelter for farm stock, improving the agricultural value of the lower lying lands, and clothing and ornamenting our bare commons and hillsides, plantations are of the utmost importance; indeed, their value in that way can hardly be overestimated. Twenty years ago I formed a plantation on a spur of the Snowdon range of hills, in Wales, where the fierce, long-continued and hard hitting blasts were of almost constant occurrence, and the amount of shelter and warmth it now affords to the farm stock and lower lying lands would hardly be credited. Previous to forming this particular plantation, which was at altitudes varying up to 600 ft., the adjoining lands were quite incapable of cultivation, but now crops are gradually creeping up the hillsides, while the farm stock find the much-needed shelter and warmth that they were formerly denied. So great has been the benefit of this wood both to man and beast that the farmer on whose land it was planted speaks of it as a God-send. Other similar cases in

Wales might be mentioned, as on the Gwydyr Estate and near Abergele, when the judicious planting up of rocky, almost worthless land has converted dreary and inhospitable districts into the most fashionable and expensive residential property. But in many parts of Scotland, particularly Perth, Inverness, and Aberdeenshire, equally good results have been obtained by judicious tree planting.

Then there is the equally important advantage of finding profitable work for the unemployed, but as a special chapter is devoted to that important subject, it need only be mentioned here. Excellent results, too, have followed in the wake of planting bog lands in Ireland, and in 1862 my father formed several plantations there, a full account of which will be found in the "Transactions of the Highland and Agricultural Society of Scotland" for 1873. I examined these woods in 1900, and was agreeably surprised at the height to which the trees had attained, the cubic contents of timber, and price realised. Incidentally, it might be noticed that the ground previous to planting was a dreary, heath clad waste, and only of value for snipe-shooting and the production of turf for fuel. But many such cases of the numerous advantages of tree planting could be cited.

But there are other advantages to be derived from a well-organised scheme of tree planting, not the least important being the greater facilities that would be afforded for disposing of the timber. In many outlying districts all over the country that are far removed from road and rail, it is difficult to get rid of the small amount of timber that is periodically cut down, but were larger quantities and a continuity of supply forthcoming, I feel certain that timber merchants would be prompted to make special transit arrangements. More than once I have been asked by Irish landowners to recommend buyers of good larch and oak timber, but, after negotiating, I have invariably been told by the merchant that the quantity offered was far too small to allow of special facilities for delivery being entered into, the timber, too, being far removed from road and rail. They stated, however, that if a specified number of cubic feet of good timber could be guaran-

teed annually for a number of years, they were quite prepared to buy, especially oak and larch, both of which had a good sale in England. The same has been the case with timber in Scotland and remote parts of Wales. These, then, are cases in which a continuity of supply, as would be quite possible, if my scheme of afforesting was carried out, would insure speedy sales at moderate prices in places where at present it is difficult, if not impossible, to dispose of small quantities unless at ruinously low prices.

AFFORESTATION AND THE UNEMPLOYED.

The question of utilising unemployed labour in the planting up of some of the waste lands of our country is not one of recent birth, as may be seen from early editions of my "Forester's Diary," and from special articles which have appeared in the *Timber Trades Journal* and other papers. As this question is now attracting much attention, and as there are indications that the Government contemplates legislating upon the subject at an early date, I will briefly recapitulate what has already been said, with some further suggestions as to how unemployed labour could to some extent be utilised in the formation of plantationsr. Confronted as we at present are with the serious question of the unemployed, a practical solution of the labour problem would, in my opinion, be found in the planting up of some of the vast tracts of waste land which are to be found in many districts of the country. In order to carry out my proposed scheme of planting 40,000 acres annually for a period of twenty-five years, profitable and healthy employment would at once be found for about 1,100 workmen for about half the year at each of the four stations in England, Scotland, Wales, and Ireland. The question of transporting, housing, and otherwise dealing with these workmen has been brought forward as the most serious drawback to the scheme, but personally, having had to deal with such cases, I can see no insuperable difficulty in the way; and surely, if our railway and water companies, as also private landowners, can deal with hundreds of men in remote mountain districts that are far removed from road and rail, the Government could arrange the necessary accommodation for

the various bodies of workmen that would be employed in afforesting purposes.

The present system (in London and the district around, at least) has several drawbacks, but by drafting these men to the country where work that is remunerative in every way is staring us in the face, much good both in an economic and hygienic sense would be brought about. Even amongst the drunken paupers, which cost the London ratepayers over a million pounds annually, many are well suited for country work, which would not only be providing them with healthy employment, but be the means of removing them from the way of temptation. Neither are the so-called unemployed, the idle, thriftless loafers, they are usually designated, for with a considerable experience of them both in London and the country, I must say that when properly managed they are both civil in manners and very good workmen. Nor must tree-planting be considered as a new departure for unemployed labour, as in the formation of a large plantation on a dreary, exposed hillside in Wales the whole of the work—including clearing the ground of surface growth, pitting, and planting was carried out under my supervision by a detachment of the unemployed. Large sums of money have been subscribed for in London and the provinces towards providing work for the unemployed, much of which work is, so to speak, created and would never have been entered into but for the exigencies of the case. Now I am quite of opinion that afforesting waste land offers a far more sensible way of expending such money, for it is now generally admitted that a largely increased area of our woodlands is imperative, and a pressing necessity, and, what is of equal importance, the undertaking, if wisely entered into, would not only increase the value of such lands sevenfold, but form the nucleus of an ever-increasing revenue of the State.

But this is not all, for, apart altogether from the question of immediate labour, what an industry would be opened up in years to come by the planting of waste grounds. At present there would be the clearing, draining, fencing, and planting the ground, then tending would give employment. Thinning would commence

at about the tenth year, after which the erection of saw mills and converting the timber would open a vast and ever increasing industry, as well as find highly remunerative work to thousands of the unemployed. A wood-pulp industry, too, is looming in the distance, and when a sufficiency of spruce timber is available a great paper manufacturing industry is sure to spring up. Spruce is more valuable now than Scotch fir, because practically all the paper of the world is made out of this wood. The produce of 5,000 acres would be required to keep each pulp mill going, and the spruce for this purpose would be cut down at the age of thirty years.

In the little kingdom of Saxony no less than 4,000 factories, employing 60,000 people, have been brought into existence by wood-pulp, paper, and other manufacturing industries in connection with her well-managed and highly profitable forests.

It has been argued that as tree-planting is skilled labour the unemployed are unsuited for it. But the main part of the preliminary work—draining, clearing the ground, forming roads and pitting—in fact, every operation, if we except inserting the trees, is such as can be carried out by any ordinary workman.

AFFORESTATION AND A SCHOOL OF FORESTRY.

Now that the Government has practically decided that the foundation of a School of Forestry is necessary, the questions crop up where and how should such be established? No better position than in connection with the afforesting of waste lands could be suggested, every facility for the education of foresters and woodmen being present. First, there would be clearing, draining, and fencing the land, tree pitting or notching and planting, after which tending the woods, thinning and disposing of the woodland produce either in a converted or unconverted state would give an insight into the cultivation of timber which could not so well be otherwise obtained. The greatest drawback in connection with existing forestry schools is the want of woodlands, the result being that theoretical teaching has given place to a great extent, at least, to the practical work. The Forest of Dean School is a late exception. More than once I have had pupils from our highest

schools of teaching come to me to ascertain the names and peculiarities of our forest trees and native timbers. In order to have first-class managers of our wooded estates, it is imperative that the whole curriculum in connection with forest management, from laying out the ground to disposing of the produce, be gone through and this will require five years at least to be spent in the woodland. As suggested to the Board of Agriculture, four Schools of Forestry might be initiated in connection with the afforesting of waste lands—one in England, Scotland, Wales, and Ireland Each school to be under the charge of a smart, well-educated British forester, whose duty it would be to superintend generally the laying out, fencing and planting of such grounds as the State had acquired for the purpose, as also to impart to the assistant Foresters at classes held in the evenings, or at other times, such knowledge regarding the various outdoor operations as could not well be taught in the open. Preparatory to entering the State forests, each pupil should have served at least three years on an estate where the management of woodlands was carried out, it, of course, being assumed that he had received a fair education. These assistants would act as foremen, and see that all work sketched out by the head forester was properly carried out and impart such advice as might be necessary in connection with the every-day duties of the assistants About five students could be kept at each of the four schools in England, Scotland Wales, and Ireland, and, as my proposal is to plant 1,000,000 acres, this would give 250,000 acres for each of the four countries, which, spread over a period of twenty five years, works out at 10,000 acres to be dealt with annually at each of the stations. I have purposely spread the planting over a period of twenty-five years in order to reduce the annual expenditure, and so as to insure that by the time the last portion was dealt with the first-formed would be annually producing a fair and increasing quantity of timber. Other portions would be coming on gradually in rotation, so that by the end of the twenty-fifth year almost every phase in connection with the management of woodlands would be in hand. It will be necessary to erect a substantial building at each of the four stations for the accommodation of the head forester

his staff of assistants, lecture rooms, and storage places for tools and other commodities. The assistants should remain at the School of Forestry for a period of not less than three years, after which they may be allowed to fill vacancies as head foresters when such crop up. By this means not only will the assistants receive a good insight into forest work generally, at a fair remuneration, but the State would greatly benefit by the employment of such men in the laying out, planting, and management of the woodlands. During that period of the year when thinning cannot be engaged in, there will be plenty of work in the way of fence repairs, drainage, removal of rough-growing grasses from newly planted sections, and other needful operations, while when the conversion of the timber comes about, greatly increased facilities in the matter of saw mills and other buildings will be required, and work will be general the whole year through.

The practical part of the education might include draining, fencing, planting, pruning, thinning, timber conversion, seasoning, and preserving, as well as measuring and valuing, levelling, surveying, road-making, and the formation and management of tree nurseries will all require attention. The home classes might include entomology, as far, at least, as the life history of insects injurious to trees is concerned; bird and animal life, chemistry, geology book-keeping, plan drawing and forest botany. During their stay in the State woods each pupil should receive a weekly wage of 25*s.* per week, with use of rooms and free attendance at evening and other classes. For purely technical purposes these woods will not have arrived at their greatest value till after, say, twenty years, but previous to that the pupils may receive benefit by an occasional visit to some of the old Crown or private woods, where the felling and converting of heavy timber is in operation. From twenty-five years onwards the Crown woods will afford every facility necessary for the education of the young student. By such a system of procedure our foresters will be enabled to gain a thorough practical knowledge of woodland work generally at no appreciable cost, while the State will receive at the same time valuable aid from the students at a small outlay per annum.

Regarding the most desirable places to establish these Schools of Forestry and commence planting operations, I would suggest those counties where not only the greatest area of waste lands exist, but where other advantages are offered, especially in the matter of cheap land purchase and easy removal of the produce. Thus we have—

ENGLAND.—Yorkshire and Northumberland with 1,019,924 acres.

SCOTLAND.—Inverness and Argyleshire with 3,087,412 acres.

WALES.—Breconshire and Merionethshire with 461,320 acres.

IRELAND.—Donegal and Kerry with 657,337 acres (exclusive of 172,436 acres of bog land).

From these figures it will be seen that were such necessary, we could get all the ground required for the present afforesting scheme in one county of England and Scotland and three of Wales and Ireland.

Such a course, however, might be undesirable, and the better plan would be to take portions from two counties of each of the four countries.

CONCLUDING REMARKS.

In conclusion I might add that, taking everything as above into consideration—price of land, cost of fencing and planting and financial returns—it will well repay the Government to plant up uncultivated and waste lands, work that there should be no loss of time in getting about, if we are to avoid the threatened timber famine, which the well-informed in such matters tell us is so fast approaching. There are one or two matters in connection with the formation of plantations that I must not omit to briefly mention and on which the success of the undertaking largely depends. These are:

1. Strict economy in the formation of the plantations.
2. Suiting trees and soil, and studying local demand and conditions.
3. Careful and timely thinning, bearing in mind that the timber is being cultivated wholly for its economic value.
4. A bold, well-planned and continuous policy.
5. Efficient supervision.—(*Timber Trades Journal*).

ORIGINAL ARTICLES.

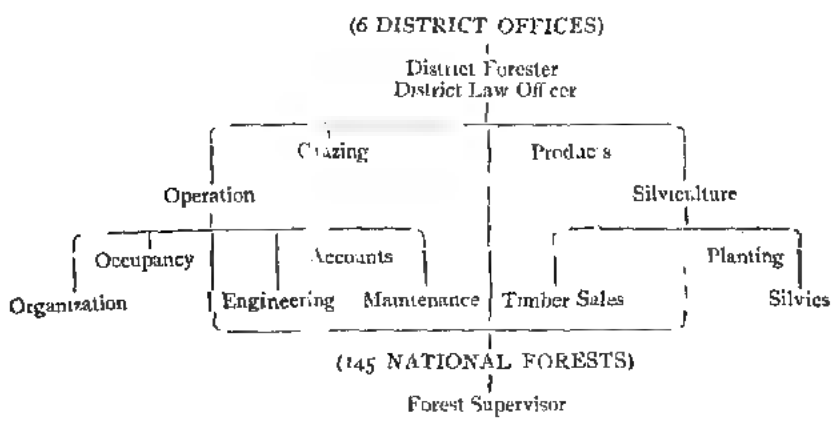
THE AMERICAN FOREST SERVICE.

Few Indian Foresters realise that the actual administration of National Forests in America by trained Foresters really dates from February 1st, 1905, when the then-called Forest Reserves were transferred from the General Land Office of the Department of the Interior to the Bureau of Forestry, Department of Agriculture. At that time there were no trained Foresters in charge of forests, and the sale of timber and its detailed management was still undeveloped and in rather a crude form. It is amazing to note the phenomenally rapid progress that has been made. On December 31st, 1908, the acreage of National Forests had increased to 168,681,039 acres, including a grand total of 145 National Forests. In this district the area on February 1st, 1905, was 10,121,240 acres: on January 1st, 1909, it had increased to 24,936,453. This increase in area has been brought about by a careful field examination of all vacant public land, and such portions as were covered by a forest growth have been brought under forest administration as rapidly as possible. Even during the year 1908 the increase in area of National Forests was 11 per cent; increase in timber sales, 235 per cent; increase in amount of timber cut, 102 per cent, and increase in grazing permits, 11 per cent. This serves to illustrate very clearly that the American Forest Service is still developing and has not reached its final size. As the public becomes more familiar with the need of National Forests and the great benefits to be derived from being within protected areas, petitions are received from stockmen and others asking that additional land—often scantily wooded—be included within the boundaries of existing forests. Perhaps the best way to explain this successful growth and to show how opposition has been overcome, is to say that the Forest Service has always been extremely liberal in the distribution of practical and scientific publications. By doing this the public has been gradually educated and they now come to

Note.—Acknowledgment is made to official instructions, manuals, news bulletins, etc.

look upon the Forest Service as a necessity rather than a luxury. It is evident that if public opposition had not been overcome, Mr. Pinchot's work would have been delayed many years and what he has accomplished in four years might have taken fifteen or twenty.

The growth of the Forest Service has been so rapid that on December 1st, 1908, it was found necessary to divide the executive work into six district offices. It was thought by doing this that the enormous amount of routine that weighed down the central office in Washington would be distributed and decreased and at the same time the executive offices would be in closer touch with the actual field administration. This new organisation has now only been in effect two months and yet I am very sure that it has proved a success and that it is a permanent change. The new organisation delegates only extremely important administrative work to the Forester in Washington, whereas the actual executive work is now carried on by District Foresters assisted by four Chiefs of Office, who have in turn sections under them that actually write the majority of the letters for signature and handle less important routine. The Forest Supervisor, who has charge of each National Forest corresponds directly with the District Forester, whereas the District Forester corresponds with the Forester in Washington, where particularly important problems arise, and chiefly where a new policy or modification of an old policy is involved. The new district organization is shown very clearly in the following table :—



District Organisation of the Forest Service.

The district organisation provides that the District Forester shall sign all very important letters, whereas the Chiefs of Office are the main executive officers. The four offices are—(1) Operation, (2) Grazing, (3) Products, (4) Silviculture. Operation includes all executive action involving change in personnel, allotments, administration of land laws, improvements, supplies, accounts, maps and ordinary routine, except as is included in the three other offices. Grazing has complete control of grazing and closely related subjects such as the erection of drift fences, improvement of the water supply, pasture and the like. Products include mainly the treatment and preservation of timber, wood utilisation, publication, and compilation. Silviculture has the same relation to the District Forester as a chief engineer has to the president of a railroad. Its duties are the supervision of the sale and free use of timber except final decisions in sales above the prescribed limit (at present 10,000,000 board feet; 1,000 board feet equal approximately 2 cords or 256 cubic feet); supervision of planting and silvical investigations, in fact, all technical forestry is under this office and in addition the actual administration of the more important technical business on each forest.

The organisation of the National Forests is somewhat similar to the executive staff maintained in British India. Each forest is in charge of a Forest Supervisor, who usually has as his assistant a Deputy Supervisor, who alternates with him as executive officer. This enables the officer in charge to spend approximately one-third to one half of his time in the field. Each forest district is in charge of a Forest Ranger, and where the importance of the district justifies it, he is assisted by a Deputy or Assistant Ranger or a Forest Guard. The duties of these officers are approximately the same on account of the newness of the organisation and the practical inexperience of most rangers, because the rapid creation of new forests has made many vacancies that had to be filled from officers of the ranger force. The Supervisor's force is often supplemented by a Forest Assistant, who has special supervision of the technical work. This officer ranks below the Deputy Supervisor

but above the ranger, and the position was created in order to train technical men for administrative position without giving them the actual responsibility that practical Supervisors, who knew the routine and understood local customs, could more readily assume. Lumbermen are also appointed who have a thorough knowledge of scaling and the management of large timber sales; they are assigned to the district office under the office of Silviculture, but when on National Forests work directly under the local officer in charge and report through him. Where the local force is not sufficient to administer large timber sales, scalers are sometimes permanently assigned, whose sole duty is to measure the timber as it is cut. When permanent forest nurseries are established, planting assistants are assigned to take charge. They work under the direction of the Supervisor and yet in reality, since the operation of large nurseries requires detailed technical knowledge, the actual administration is from the district office through the Supervisor. Each officer in charge is provided with one or more clerks, who are usually stenographers and have charge of the official records and other routine. By this arrangement alone could the mass of correspondence be efficiently and promptly handled.

During June 1908* when business was heavier than at any other time during the year, the National Forests were cared for by an executive and protective force of 29 Inspectors (at present there are only two Inspectors since the district officers will now inspect when on field duty), 98 Forest Supervisors, 61 Deputy Supervisors, 33 Forest Assistants, 8 Planting Assistants, 941 Rangers, 521 Forest Guards and 88 clerks. This does not, of course, include the present District or Washington force. In this office under the new organisation the district executive force includes 1 District Forester, 1 Assistant District Forester, 7 Chiefs and Assistant Chiefs of Office, 9 Chiefs and Assistant Chiefs of Sections, 21 technical field officers, mostly in silviculture, and 31 clerks, or a total of 70. The forests in this district are administered by 16 Supervisors, 1 Acting Supervisor, 8 Deputy Supervisors,

* Official news bulletin.

5 Forest Assistants, 4 Forest Planting Assistants, 12 clerks, or a total of 46; there is in addition a field force of 178 rangers and other officers. It is at once apparent that the district office force of 70 is large in proportion to the total of 224 actually in charge of the forests.

One striking difference between the Indian Forest Service and the American Forest Service is the matter of salaries. The present low scale of pay in the Forest Service is causing a great deal of dissatisfaction, and unless it is increased in the future, it will be utterly inadequate to properly support a forest officer *and his family.* At present it is uniformly the rule that officers receive their actual travelling and living expenses when away from their official headquarters. With an unmarried officer this ekes out the present salary and is ample for his support. Where men have families and their expenses go on practically the same whether they are in the field or in the office, the present scale of pay is utterly inadequate. In order to forcibly illustrate this, no better method can be adopted than to actually give the salaries that are being received by District Officers and by Supervisors. In District 3—the South west—(includes the States of Arizona, New Mexico, Oklahoma, Arkansas, Florida, Texas, etc.) the District Forester and Assistant Forester each receives approximately Rs. 550 per month; District Law Officer Rs 300; the Chief and Assistant Chief of Operation Rs. 425, the Chief of Grazing Rs 450, the Assistant Chief of Grazing Rs. 474 (this shows the Assistant Chief to be receiving more than the Chief, which is correct in fact, but will be changed at the next promotion); the Chief of Products Rs. 375, the Chief and Assistant Chief of Silviculture Rs. 450 and Rs. 400 respectively. The average Supervisor's pay at present is Rs 425; Deputy Supervisor 375, lumbermen Rs. 450; scalers Rs. 375, Forest Rangers Rs. 300; Deputy Rangers Rs. 270; Assistant Rangers and Guards Rs. 225. One point that first merits attention is the relatively high pay of the subordinate force and the relatively low pay of executive officers. This is partly accounted for by the high scale of wages in the west for manual labour and at the same time by the newness of the Forest Service,

which has prevented officers from receiving the pay belonging to the positions they are holding since their promotions have been so rapid. The position of District Forester who has charge of some 15 to 26 National Forests (in District 3 the area is 25 million acres), should be about 50 per cent more than the average Conservator in India, whereas in reality I presume it is actually one-third to one-half of what the older Conservators are receiving, although exact comparisons are hard to make since in the United States officers receive their actual field expenses; in 1908 my own official expenses for which I received reimbursement amounted to about Rs. 3,000. Personally, it appears that the present low scale of pay is due sole*ly to politics and would Congress approve of a materially higher* rate of pay, Mr. Pinchot would be only too glad to secure it for the men who are serving him so faithfully.

During the fiscal year* July 1st, 1907, to June 30th, 1908, the Government spent for the administration and protection of the National Forests (one dollar about 3 rupees, and 2 cents = 1 anna) \$2,526,098.00 or about 1½c. an acre. Permanent improvements, including the construction of 3,400 miles of trails, 100 miles of wagon roads, 3,200 miles of telephone lines, 550 cabins and barns, 600 miles of pasture and drift fences, 250 bridges, and 40 miles of fire lines, cost \$590,169.00. Although many needed improvements could not be commenced, the benefits of permanent improvements are at once evident. The type of man, who can be secured for Forest Ranger, is very much superior when he sees himself provided with comfortable, decent quarters, and this is probably borne out by the results of long experience in India, where I understand it is considered false economy to erect mere huts or cabins for officers to live in. During this same year the receipts from timber sales, grazing fees, and permits for special uses (leases) amounted to \$1,842,287.00, an increase of \$271,222.00 over the previous year. The per acre receipts from the National Forests were a little more than one cent, less five mills, under the per acre cost of administration and protection of the forests.

* Official news bulletin figures.

Since National Forest lands are not subject to taxation, 25 per cent of the gross receipts are paid each year to the States and territories, and this has proved to be a very wise policy since it has decreased a discontent in counties where vast areas were necessarily withdrawn from taxation. The public received 30,714 free use permits for timber, amounting to 131,582,000 board feet worth $168,720.00. During this year 1,768 special use permits were issued in addition to 963 which were in force during the previous year. The grazing receipts amounted to $962,829.00. Receipts from timber sales $849,027.00 and from special uses $30,425.00.

It is particularly interesting to note the increase in revenue from the sale of timber since the forests came under the Forest Service administration: in 1905, $60,137.00; 1906, $245,013.00; 1907, $668,813.00; in 1908, $849,027.00. It is probably similar to the increase of revenue, which has been going on in India and which, I fear, in some cases has developed in over-cutting, in other words, in selling forest capital instead of the actual legitimate revenue. This very criticism has been made of many National Forests in this country, whose officers falsely believe that high revenue means efficiency.

On National Forests the approximate average area patrolled by each subordinate officer was 116,000 acres. Since more than three-fourths of each officer's time is taken up by routine in timber sales, special use cases, and grazing, in point of fact, the force on duty at the close of the fiscal year provided about one patrol officer to each half million acres of forest. It is very evident that this is totally inadequate for a proper administration and in the future the force will have to be materially increased. The estimates for the fiscal year 1909-1910 will probably provide for an increase of some thousand rangers over the present force.

It is quite natural that Indian forest Officers should be chiefly interested in the present status of technical Forest work and particularly in the regulations governing the sale of timber; therefore more time will be devoted to this topic than to any other. On the other hand, it may be interesting to have a brief digest of the regulations governing other branches of the Service.

Under the various land laws there is considerable alienated land in each National Forest. It consists chiefly of homestead claims, timber and stone claims, mining claims, mill-sites, town-sites, state, school and university lands, and railroad grant lands; but these are gradually being reported upon and either cancelled for fraud or else patent issued. At present this is a very important branch of the work. One of the greatest criticisms of the Forest Service originally arose from the fact that after a forest had been proclaimed, *bonâ fide* settlers and homebuilders were unable to secure patent to lands unless they had already settled. The Act of June 11th, 1906, allows eligible citizens to take up, not to exceed, 160 acres of land *chiefly valuable for agriculture*. The examination of these claims has entailed an enormous amount of work, but finally one will see the fertile valleys under cultivation and the forests intensively used, as is now the case in the Black Forest of Baden. It has been the policy, and it is a good one, to withdraw from all form of entry land that is or will be needed for administrative use, either for nurseries, ranger stations or for any other administrative purpose. For example, where there is a valley with splendid agricultural land in the bottom with the hillsides heavily timbered, it is now possible for a settler to take up just the portion valuable for agriculture, no matter how irregular its shape, provided it does not extend more than a mile in length and is not needed for administrative use.

*"Special use permits are issued for residences, farms, pastures, drift fences, corrals, schools, churches, roads, trails, telephone and telegraph lines, stores, mills, factories, hotels, stage stations, sanitoriums, etc., and in fact for almost any legitimate use. The charges of these permits are not based on the actual renting value of the land, since it is desired to aid *bonâ fide* residents so for as possible. For example, pasture land usually rents for from two to three annas per acre per year; the charge on residences may be 15 rupees per year; agricultural land may be rented for one rupee 8 annas per acre per year, and for certain forms of leases no charge whatever is made, as cemeteries, churches, corrals (in connection

* The Use Book.

with grazing permits), free dipping vats, drift fences (in connection with grazing permits), reservoirs, miners and prospectors' cabins, schools, roads and trails, sawmills where sawing National Forest timber."

The disposal of timber is of especial interest. It can now be disposed of in three different ways :—

1. Administrative use when such disposal is actually necessary to protect the forest from ravages or destruction or when it is necessary for use in improvements or experiments. For example, a company desiring free telegraph poles could secure them by granting the Forest Service a free lease of the lines within National Forests.

2. Free use is granted to settlers, farmers, prospectors or similar persons, who may not reasonably be required to purchase. Usually not more than Rs. 60 worth is granted to any one individual during a fiscal year, but schools and co-operative institutions may receive Rs. 300 worth and even more where special conditions warrant it. It is desired that the free use of timber be managed just as carefully as the cutting in any ordinary timber sale.

There are three classes of sales : —

(*a*) Ranger's sales, not over $50.00 in value, of dead or living timber. These may be made by the Ranger himself.

(*b*) Supervisor's sales ; not over $100.00 in value except in special cases where particularly efficient Supervisors have the right to sell up to one million board feet.

(*c*) Forester's sales ; sales exceeding in value the amount which the Supervisor is authorised to sell. This has recently been modified by what would be termed "District Forester's" sales, which in this district amount to ten million board feet (one thousand board feet equals approximately 2 cords or 256 cubic feet ; this varies, however, with the size of the timber).

A brief digest of timber sale regulations may be of interest :— Timber must be paid for in advance and the period for removal

will in no case exceed five years. Bonds will be required only in exceptional cases, usually only when the value of timber sold is over $3,000.00. No timber will be removed until it has been scaled and measured or counted and stamped. No live trees can be cut until marked or otherwise designated. All timber valued at over $100.00 must be advertised for at least 30 days before being sold. "In sales above $500.00 allotments at the highest price offered may be made to several bidders to prevent monopoly." Cutting in advance of the award in an advertised sale may be allowed in emergency.

These embody the chief regulations governing the disposal of timber.

Many of the grazing regulations, I believe, could be applied directly to certain forests in British India. The forests, in which grazing is allowed, are divided into districts approved by a superior officer and the number and kind of stock to be grazed are determined beforehand.

Every one grazing in a National Forest must secure permits, except settlers and the like are allowed ten head of certain stock to be grazed free of charge and prospectors, campers and travellers can graze their actual pack horses and saddle-horses free of charge. Crossing the National Forests without a permit is likewise prohibited. Permits are granted only for the exclusive use and benefit of the owners and no speculation in range allotments is allowed. Disputes between Supervisors and grazing applicants may be appealed to the District Forester or Forester. Where the grazing of cattle, especially of large cattle companies, is partly within and partly without the National Forests, the grazing fee is based upon the average number grazed. The fees are exceedingly low and do not represent the actual value of the range, for instance, in Arizona and New Mexico the average fees are as follows:—

Cattle, summer season, *20c.*	Year long, *35c.*
Sheep, summer season, *7c*	Year long, *12c.*

The fees are, of course, payable strictly in advance, but refunds are made on non-use of the permit when the applicant is prevented from using the range by circumstances over which he

has no control. Owners must notify the nearest Forest Officer before stock is driven upon a forest under a permit. Grazing permitees must repair all damage done to range improvements. Sheep and goats must not be bedded more than six nights in succession in the same place except under unusual circumstances and must not be bedded within 300 yards of any running stream or living spring. Carcasses of animals which die near water must be removed immediately and buried or burned. Stock must be salted as required by the Forest Officers. Particular care must be taken to extinguish camp fires. The range must not be over-grazed or damaged in any way. Crossing permits must be secured before driving unpermitted stock across a National Forest. Drift or division fences will be allowed when they are a benefit to the National Forest administration and do not interfere with the proper use of the range. Corrals may be constructed of not more than one acre. Pastures may be maintained not to exceed 320 acres except under special circumstances. Stock watering tanks may be constructed and enclosures not to exceed 40 acres may be allowed in order that the owners may have the exclusive use of water they themselves have developed. Wild grass is sold at a minimum charge of 20c. per acre. Quarantine and territorial stock laws must be observed and the protection of game under the State and territorial laws is enforced.

Under the present system the range is allotted roughly to cattle and horses; usually these run unherded over the forest and allotments are made only by very broad watersheds or other natural subdivisions and often cattle drift hundreds of miles from their actual home allotment. With sheep and goats it is entirely different. These are allowed definite areas either by surveyed bounds or by natural subdivisions and they are required to remain within these limits. The areas that are allotted sheepmen or goatmen may also be within the allotments given to owners of cattle or horses. There is now a tendency to allow the fencing of certain portions of the range where owners are entitled to preference and have already fully occupied the area, but the actual fencing of ranges will not become general for many years, since

small owners cannot afford it and all policies of the Forest Service are designed to protect the small man.

The protection against fire has been most successful; during the fiscal year, 1907-1908, the area burned over amounted to less than one-tenth of one per cent of the total area of the National Forests. All permits contain the stipulation that the permitees shall aid in extinguishing fires; stringent rules are maintained to prevent the wilful setting of fire or for leaving fire to burn unattended. Special regulations cover such details as the size and method of building camp fires. Each ranger is given a certain patrol during the dangerous season and, where necessary, additions are made to the local force to insure efficient protection. It will, however, never be possible to equal the advanced fire-protection by *means of skillfully located fire lines that is already established in* British India. The cost of labour in the United States is too high to admit of such detailed work. There will be, however, one or two exceptions to this and fire lines are already being constructed on quite intensive scales on several forests in Southern California.

The most important section of trespass is naturally timber trespass; the actual cutting is usually done before a National Forest has been proclaimed. The policy is a very lenient one and the law for the measure of damages is: if a trespass is innocent, the value of the timber on the stump; if wilful, the value of the timber when seized, and 95 per cent of trespass cases are settled upon an innocent basis without resorting to the courts. Grazing trespass is also usually settled on a liberal basis and it is rarely that more than double the value of the grazing fee is assessed as a measure of damages.

In order to *systematically handle the improvements, which* are not governed by any regulations other than the provisions of the annual agricultural appropriation bill for the fiscal year, Sections of Engineering were established in each district. The present bill provides that no building shall cost more than Rs. 1,500, which is naturally a very undesirable provision. Simple, concise instructions cover the building of roads, trails, bridges, telephone lines and headquarter buildings. Standard specifications

are provided for "rest houses," but even with the work systematised as it is there is room for tremendous improvement. While quarters are being provided for Rangers, no attempt is made to provide for Supervisors and higher executive officers.

The demarcation of the boundaries of National Forests is in poor shape. The system in the United States cannot compare with the splendid boundary demarcation that is usually found in India; instead of permanent masonry boundary posts, one would be more likely to find a flimsy cloth notice tacked up on a tree, perhaps supplemented by a mere blazed line. This, however, is a necessary evil until the final boundaries are permanently established. Where frequent changes are being made it would hardly pay to go to the expense of permanently marking them In some cases some semi-permanent tin notices have been printed and posted as a makeshift until the final survey established the boundary.

As I said before the technical work will be of the most interest to the Indian officers, and, therefore, I shall describe in some detail the routine of the Office of Silviculture, of which the writer at present has charge for the south western district. In the first place all letter writing is solely by dictation, and where it is necessary to work after hours the dictation is given into a phonograph run by electricity, which in turn dictates, at whatever speed desired, directly to the typewritist. Some 200 to 400 letters a week are received and answered, including all timber sale contracts of importance and other agreements. The Section Chiefs actually answer most of the letters, while the Chief of Silviculture and the District Forester sign them. A very high standard of correspondence is maintained and it is not infrequent that letters are returned three or four times for correction until they are in the exact form desired. A complicated filing system by subjects and cases (a definite timber sale would be termed a case) is maintained in the central file room and a carbon copy of every letter written is provided in order that there may be a complete history of all action that is taken. While it is hardly worth while to go into the details of office routine, yet the case designations that appear at the head of

each letter may be interesting. For instance, if a sale of timber on the Pike National Forest is made to a man named J. H. Jones on January 20th, 1908, each relating letter has at the head the following designations:—

ST.
Pike, Sales, Jones, J. H.,
January 20, 1908.

By this procedure any one familiar with the routine can tell at a glance that the letter originated in the Timber Sale Section of Silviculture, and that the sale was made on the Pike Forest to J. H. Jones on January 20th, 1908. Similarly, if correspondence relates for instance to "sale policy" on a definite forest, the letter would be headed

ST
Pike, Sale Policy.

Naturally the most important work of silviculture is the making of timber sales; and it should be clearly understood that it has not been possible as yet to complete detailed working-plans and consequently the sale of timber is somewhat as follows:—

A sawmill man on a National Forest sees a body of timber he wishes to purchase. He applies to the local officer, who sees that a detailed field examination is made to determine whether the timber should be cut, silvical treatment, future stand to be retained, the area to be cut over, the prices to be charged, the methods of cutting and marking. In addition to the actual report, a map is prepared showing just where the timber lies particularly with reference to topography and alienated land. This report and map, if it is a District Forester's or Forester's sale (this includes all important sales of timber), is forwarded to the District office for approval. If approved, after proper advertising a detailed contract is drawn up and then the local officers have actual charge of the cutting. Since the contract illustrates many interesting points in sale policy, I am quoting the rules for cutting from an agreement in a recent important sale in this district. The sale was chiefly of yellow pine (similar to chir pine of the Himalayas) and was for ninety million feet at $3.50 per thousand, or a total of $315,000.00.

1. Boundaries of the cutting areas shall be plainly marked by the forest officers before cutting begins; all timber designated by the forest officers within such boundaries shall be cut, and no tops, brush or débris shall be left on adjoining lands.

2. Timber upon valid claims is exempted from this sale. Timber on reconveyed railroad lands cannot be cut under this contract until the reconveyances have been accepted by the United States Department of the Interior. Timber on such reconveyed lands as are accepted during the life of this contract shall be cut and paid for in accordance with all and singular the provisions of this contract.

3. No living trees shall be cut until marked by the forest officers; and all trees cut which are not marked shall be scaled and paid for at double the contract price.

4. All marked trees and all dead timber sound enough for railroad ties or merchantable lumber of any grade shall be cut; and all marked trees, and all merchantable dead timber left uncut, and all timber in tops, stumps and partially sound logs which is merchantable in the judgment of the forest officer and which is not removed from the National Forest after logging on that portion of the cutting area on which they are found is completed, shall be scaled and paid for at double the agreed contract price.

5. No "black jack," unless defective, shall be marked. All merchantable yellow pine shall be marked, except that the forest officer may, in his discretion, leave unmarked not to exceed four yellow pine trees per acre above 20 inches in diameter outside the bark at a point three feet* from the ground, and such number of trees below this diameter as he may deem advisable.

6. No avoidable damage shall be done to young growth or to trees left standing, and no trees shall be left lodged in the process of felling.

7. If live trees not marked for cutting are injured in the process of logging under this contract, full payment shall be made for their total contents in board feet, log scale at double the agreed contract price.

* At present all diameter measurements are at a point 4½ feet from the ground.

8. All tops and débris caused by logging, including the large chips made in hewing ties, shall be piled compactly for burning at a safe distance from living trees. It is not required that logs unmerchantable by reason of defect be piled.

9. All felling and cutting shall be done with a saw, when possible.

10. Stumps shall be cut as low as possible, not higher than 18 inches, except in exceptional cases in the discretion of the forest officer in charge.

11. The stem of each tree, when merchantable, shall be used to a diameter of 8 inches, inside the bark, in the top. If ties are hewn, so much of the stem of each tree as will make a log 16 feet long and 16 inches or more in diameter outside the bark at the small end, shall be cut into saw-logs to be scaled (measured).

12. All material shall be skidded or piled for scaling or counting with ends even on one side of skidway or pile, in workmanlike manner, and the length of each log shall be marked on the small or scaling end by the purchaser. Logs shall not be banked in such a way as to render proper scaling difficult

13. The maximum scaling length of all logs shall be 16 feet, and greater lengths shall be scaled as two or more logs.

14. All timber except 8 ft. hewn railroad ties shall be scaled using the Scribner Rule, Decimal C; all hewn railroad ties shall be counted as 30 to the thousand feet, board measure, log scale.

15. No timber shall be removed from the cutting area until it has been scaled or counted, and has been stamped on the end by the proper forest officer; and no timber shall be placed on any skidway or pile after scaling or counting of that skidway or pile has been completed, without notice to the proper forest officer. Railroad ties, as well as saw timber, shall be understood to be included under the designation of timber within the meaning of this section.

16. Scaling shall be done as often as practicable while cutting is in progress, and copies of scale reports shall be furnished the purchaser after they have been approved by the forest officer in charge of the National Forest.

17. So far as is reasonable, all branches of the logging shall keep pace with each other, and in no instance shall the brush piling be allowed to fall behind the cutting and removing of the timber, except with the written consent of the Forester.

18. All merchantable timber used for construction in connection with logging shall be scaled and paid for at the stumpage price fixed by this contract; unmerchantable live or dead timber may be so used free of charge.

19. Camps, roads, bridges, skidways, etc., required for temporary use shall be located as agreed with the forest officer in charge and constructed with care for the interests of the National Forest.

20. Sawmills, flumes, or other special privileges, if required, shall be constructed and operated only under special permit issued by the Forester.

21. During the time that this contract remains in force the purchaser and all sub-contractors, agents and employés shall do all in their power, both independently and upon request of the forest officers, to prevent and to assist in extinguishing any forest fires.

22. All locomotives operated on forest reserve lands under this contract shall use oil for fuel.

23. The use of donkey engines or steam skidders may be forbidden by the forest officer in charge upon any portion of the cutting area in this sale. If allowed, the points at which they shall be set up shall be subject to the approval of the forest officers, the ground around each shall be cleared of all brush and inflammable material, and each donkey or skidder shall be equipped with efficient spark arresters, subject to approval by the forest officer in charge.

24. No healthy living trees within 100 feet of the Tuba City Road shall be cut under this contract.

25. The violation of any one of the foregoing regulations, if persisted in, shall be sufficient cause for revoking this contract and for cancelling all permits for other privileges.

26. The decision of the Forester shall be final in the interpretation of the regulations governing the sale, cutting and removal of timber covered by this contract.

27. No member or Delegate to Congress is or shall be admitted to any share, part or interest in this agreement, or to any benefit to arise therefrom (see sections 3739 to 3842 inclusive, Revised Statutes of the United States).

The "black jack" referred to in the contract are in reality yellow pine trees usually under 150 years of age. The marking in this sale removed the mature timber by a rough selection—seed trees system; at least one third the stand was left for future growth or seed trees. The stand left was accordingly composed of young, thrifty, rapidily growing trees; together with as many of the mature stand as it was necessary to retain for the sake of securing reproduction Official marking rules are provided for each forest, and when each sale is made these marking rules are modified to meet the local requirements. In view of the large areas of the chir pine type in the Himalaya Mountains, it may be particularly interesting to note the official rules for marking a similar forest in the United States.

"PURE YELLOW PINE TYPE."

"Yellow pine stands are naturally open and on much of the land included in this type, the ground is now but partly and insufficiently stocked with young timber. In many cases the forest maintains itself against chaparral with difficulty, and reproduction depends largely upon the protection against evaporation. This makes a selection system of marking obligatory. A conservative policy is specially advisable since the areas of forest are constantly becoming more accessible to market and there is every indication of a strong future demand at greatly increased prices.

"All marking, then, should be by a conservative selection system. But the exact form of cutting must be decided according to the nature of the stand. Two conditions ordinarily present themselves:—

"First, where there are young trees present and a second cut can be obtained in about forty years Sales should rarely be made except where this is possible. In such cases at least one-third of the trees at present large enough to be merchantable must

be left for a future cutting. This means that at least 1,500 or 2,000 feet should be left to the acre; and, in heavy stands, more, up to one-third of the total stand. No sales should be made in stands so open that 1,500 feet cannot be left and the logging done at a profit. Leave all black jacks unless plainly undesirable from serious unsoundness or overcrowding, or so mis-shapen that they will not develop into valuable timber trees. In general, leave all thrifty trees which will plainly be much more valuable at the time of another cutting.

"Second, where the stand is composed wholly of mature or overmature timber or with only very scattering black jacks or healthy young yellow pines. In such cases it will be necessary to start a new crop from seed, and consequently in any cutting enough seed trees must be left to seed up the area amply. Before marking any tree for removal, therefore, be sure that it is not needed for seed, for the best trees for producing seed, irrespective of size, must be left. Young, thrifty yellow pines or large thrifty black jacks with full crowns make the best seed trees. 'Enough seed trees' usually means from two to five to the acre, the number varying with the seed-bearing capacity of the trees. If young trees that are just beginning to bear cones are left, at least five are needed to the acre. From two to four seed trees are enough if they are old and have large spreading crowns and are wind-firm. The trees left should, wherever possible, be distributed in small groups. This makes them more secure against windfall, and conforms to the grouping tendency of the western yellow pine. Leave enough seed trees even where the seedling growth is good, in order to ensure reseeding in case of fire. This method is, at best, unreliable, and should be used only in extreme cases.

"Those two conditions grade into each other and the exact method of marking to be used will require nice adjustment on the part of the Forest Officer. Arbitrary rules are useless. It is well, however, never to make an opening of more than one quarter of an acre in the forest, nor to enlarge a natural opening of a greater size, even if the trees left are mature and partially unsound, unless good reproduction is already well established

"On all of the drier portions of this type, slash should be lopped and scattered over the openings on the cut-over area. This material will aid reproduction by protecting the soil from evaporation and by gradually forming humus. Where there is danger from fire, the brush should be piled and burned on a strip approximately 200 feet wide, around the area where the brush is scattered. Where the danger from fire is extreme it may be necessary to pile and burn all the brush."

Very close utilisation is required in each timber sale; every log measured is given a serial number, is stamped U. S. and recorded in a special note book that shows the (1) log number, (2) length, and (3) contents in board feet. By this system dishonesty and inaccurate measurement is avoided since the inspecting officer can check the measurement of each log and insure it having been scaled correctly. Usually when a check measurement shows that the original scale was 2 per cent or more off, special steps are taken for securing better work in the future. Since the tops of trees (smaller than 6" to 8") as well as the débris from the crowns is usually not saleable, it is necessary to dispose of this material to prevent forest fires; therefore, the brush is either piled in "haycocks" for burning, or where the danger of fire is at a minimum, it is scattered over the ground to protect such seedlings (as are already established or those which may germinate later) from the drying winds and heat of the summer months. The tendency is more and more to take the fire risk in order to secure better reproduction by scattering the brush which is kept away from living trees. In every timber sale a close check is kept upon the cost of administration and under favourable conditions, usually in a large sale such as the foregoing contract applied to, the cost of administration does not exceed one rupee a thousand feet, or in this particular case about 10 per cent of the gross receipts; estimating and mapping the timber may cost one-half anna a thousand; marking it for cutting 2 annas; scaling and sale administration 12 annas; miscellaneous expenses 2 to 4 annas. In some cases, however, the administration of small sales, especially where widely scattered, has amounted to three rupees per thousand, and, perhaps, on account of the low

price received for the timber 25 to 60 per cent of the gross receipts.

Practical working plans are becoming one of the important branches of the work of the office of silviculture. In the United States, where everything must be handled on an extremely practical basis, detailed European methods could not be adopted at the start. Therefore, it was necessary to adopt some short cut method to prevent the annual cut from being exceeded; moreover, something had to be secured that would be immediately available and it happened to be the writer's duty to draw up a preliminary sale policy or plan for cutting for forests in this district. Briefly stated, the plan included the following for each National Forest:—

(1) Estimated total amount of timber:—

(*a*) Live saw timber.

(*b*) Dead saw timber.

(*c*) Cordwood.

(2) Amount of timber sold since creation of forests to June 30th, 1908, and percentage of total stand. Amount of timber sold during fiscal year, 1907-1908, and percentage of total stand.

(3) A limitation of annual cut was established—(*a*) for saw timber and (*b*) for cordwood. This was based not upon the total stand, but upon the stand available for future timber sales. In limiting the annual cut Von Mantels' method was used and the rotation of 200 years for yellow pine and 150 years for piñon and juniper (comprising the cordwood stand) was adopted.

(4) The plan also clearly indicated whether ordinary timber sales were desirable; small local sales only; free use only; or protection.

(5) Areas in need of immediate cutting were designated as well as areas where no cutting at all could be allowed or where the available supply should be reserved exclusively for local needs.

Of course, this crude beginning cannot compare favourably with the intensive working-plans in India, but it has one distinct advantage, that is, it provides at once for the conservative management of every forest in the district. If, on the other hand, no steps were taken and no conservative plan established until all

forests were put under detailed working plans, serious over-cutting might be allowed that might be severely criticised in future years. I think the history of forestry in India will bear out this statement very forcibly.

The following is a sample of the very brief preliminary working-plan now in force on the Coconino Forest that will serve as an illustration :—

PRELIMINARY SALES POLICY

Coconino Forest.

September 1st, 1908.

1. Available growing stock	2,805,000	M. ft. B. M.	3,040,000	cords.
Protection forest, etc. ...	495,000	„ ...	4,560,000	„
Total stand estimated ...	3 300,000	„ ...	7,600,000	„
2. Maximum annual cut ...	28,050	„ ..	40,533	„
Per cent of est. stand available.	1		1·33	„

3. Immediate cutting.—If possible the future sales should be from the area upon which there is already a dense understory of reproduction west of the Leonard Canyon. This is at present impracticable without railroad facilities.

4. Policy for future sales.—As a rule commercial sales are desirable but need not be encouraged. Exceptions are (1) T *21 N, R 7 E, should be reserved for small sales or free use for residents of Flagstaff and vicinity ; (2) north half of T 21 N, R 2 E, and south half T 22 N, R 2 E, should be reserved for small sales or free use for resident of Williams and vicinity ; (3) north half T 21 N, R 2 W, and south half T 22 N, R 2 W, should be reserved for small sales and free use of residents of Ash Fork ; (4) all timber within the Grand Canyon National Monument (except dead or very defective trees) should be reserved as a recreation scenic forest.

It also seemed desirable to establish definite minimum stumpage rates for every class of material and for every forest. It had developed that Supervisors were competing with each other in raising the prices and consequently stumpage rates had been

* Much of the land is surveyed in squares of one mile each way and thus locations can be accurately described.

put into effect that were not consistent; for instance, even where forests were close together, one Supervisor might charge 1 anna each for fence posts, while the other was charging 2; therefore, it was particularly fortunate that minimum rates could be made uniform and harmonious on closely bordering forests. The rates were supposed to apply to all species that are of practically equal value with the rule that inferior species could be sold at one-half these rates. Since there is a record of every sale, the District Office of Silviculture has an exact check on the amount received. The following schedule shows the minimum prices established for one of the forests:—

	Green.	Dead.
Saw logs	$4.00 per M.	$4.00 per M.
Cordwood	.75 per cd.	.40 per cd.
Fence posts	.05 each	.05 each.
Poles, etc.	.02 ½ lin. ft.	.02 1/2 lin. ft.
Fence stays	.01 each	.01 each.

Fence posts over 7 ft long, 1*c.* for each additional foot.

The *policy governing the stumpage prices* is as follows:—

"As a general rule the use of inferior species, if at all suitable, should be insisted upon. It should be understood beforehand that the sale will include all merchantable species even if inferior.

"The same price should ordinarily be required in saw timber sales for both dead and green material. The same price should be required also as a rule for dead and green fence posts, poles, lagging and fence stays. Cordwood, however, warrants a separate price for both dead and mixed and green material. Sales should often be made for dead material alone, as it is an excellent thing to clean the stand of dead timber. As a rule the green 'cordwood' trees are required for protection on the dry slopes where they usually occur. Green cordwood should bring double the price of dead wood. Mixed green and dead wood may be classed at the same price as green since usually the percentage of dead wood is small. Where necessary the local officers should make a special price where in mixed material there is a large percentage of dead wood and where it is impracticable or too costly to pile separately.

"Class C. prices (advertised sales over $100.00) should govern free use and A and B sale prices, and accordingly where saw timber prices are high, other classes of material should be placed on a proportionately high valuation

"Saw log prices should be those secured in class C sales. The unit of measure should be the board feet unless otherwise specifically provided by the contract, and all merchantable dead timber should be included. Cordwood should, of course, be valued by the cord and if saw timber is over-cut into cordwood it should be valued at saw timber price, taking two cords as equal to one thousand board feet.

"Fence posts are worth practically the same all over the territories. There is very little commercial export of fence posts and in very few cases is it advisable to allow their export. Posts are becoming scarce in many localities and are sure to be needed in the future. On account of their local use there should be a simple standard price of 5 cents each for dead or green posts. They should always be sold by the piece. Where fence posts are longer than 7 feet, an extra charge of one cent a linear foot should be made in all cases.

"Poles have been sold by the piece without reference to length, or by the linear foot, and prices therefore have varied greatly in the past. It is rarely advisable to cut poles in yellow pine and associated species, and the use of poles should be discouraged. The prices recommended are exclusively by the linear foot, since the length problem then readily adjusts itself. These prices are about 33 per cent more than B. M. saw-log prices. Any pole which will cut a 12 foot log, 12 inches at the small end should be scaled by the board foot to that point and the remainder by the linear foot.

"Fence rails if split from dead yellow pine unfit for saw timber may be sold by the cord. As a rule poles should only be sold from dead, insect-infested or otherwise deteriorating timber—except where thinnings can be properly made.

"Lagging (used in mines for supporting galleries) has been sold by the cord, by the board foot and by the piece. If cut from

timber merchantable for saw-logs full price should be charged for the entire tree whether utilised or not. Roughly speaking, a \$2.00 (6 rupees) stumpage price means about $\frac{7}{10}$ of a cent (1 anna = 2c. roughly) each for lagging, but this would, of course vary with the size of the lagging. Usually about ⅓ of the tree cannot be utilised for lagging and must either be cut into cordwood or left in the woods. Hence if lagging is sold by the piece about ⅓ more should be secured for stumpage. If sold by the board foot, the whole tree to a merchantable saw-log limit should be scaled whether used or not.

"Fence stays (similar to posts) should be sold at a uniform rate of one cent for dead or green."

To sum up: while there is at present only one working-plan in effect and that only for a portion of one forest, yet an exact check is being kept of the sale policy annual cut and stumpage rates for the 21 forests in this district that are under administration. The total resources of this district amount to 16,394,270,000 board feet and 29,947,300 cords. The total maximum annual cut allowed amounts to 124,679,000 board feet and 155,168 cords, amounting almost exactly to one per cent (not including protection forests) of the available growing stock of the saw timber material and 1·33 per cent of the cordwood stand. Actually the annual cut will probably fall very much below this, since the cut cannot be exceeded on any forest and naturally under runs on a great many, owing to the lack of demand, business depression, etc. Therefore, a thoroughly conservative policy is assured. In looking over the large area to be covered by working-plans, two kinds of forests are given preference: first, those forests on which the timber sale business is large; second, those forests or parts of forests where a less intensive study will suffice for the present. Detailed working-plans will be made for particular watersheds where the demand is heavy rather than for the whole forest, part of which will be inaccessible for many years to come. This will correct the present crude system of merely limiting the cut for the whole forest, and since particular watersheds and districts may be overcut, this detailed change will be made as rapidly as

possible. Two outlines for working-plans are in force ; one for a very detailed plan and one for a less intensive one ; in many ways these outlines seem admirable and I am, therefore, going to the length of quoting them *verbatim*.

OUTLINE FOR WORKING PLANS ON NATIONAL FORESTS.

(*Reconnaissance.*)

PART I.

Introductory—

Nature and scope of work. Time when done. Personnel. Cost.

General Description—

The area.

Location.

Topography.

Geology and Soil.

Drainage and Streamflow.

Industries.

Agriculture.

Grazing

Mining.

Lumbering.

Population, present and future. The labour supply.

Status.

Alienated lands.

Railroad (reconveyed, covered by timber contracts, etc.)

University and School.

Homesteads, mining claims, etc.

PART II.

The Forest—

Division into blocks (according to watersheds and natural logging units. Show on map of forest).

Division into types (according to broad, natural divisions). Show on map.

Distinguish permanent and temporary types.

Describe the characteristic stand in each type

- Composition of stand.
- Age of trees.
- Size of trees.
- Condition of trees.
  - Mature or overmature.
  - Presence or absence of young growth.
    - Poles.
    - Saplings.
    - Seedlings.
  - Injury through —
    - Fire.
    - Insects.
    - Fungi.
    - Animals.
- Estimated stand of an average acre.

Total estimate for each block, according to types and species and classes of material. Separate live and dead timber. (For detailed estimates by forties see appendix.) Give also amount which should be cut if timber is sold.

Burns and cut-over areas (in forest and immediately adjoining. Show on map of forest).

Describe briefly and give acreage by blocks, if possible. Are the areas satisfactorily restocked? (For detailed description, time when cut or burnt, see Section Descriptions in appendix.)

PART III.

Utilisation—

Accessibility of timber. Brief description by blocks. By what means and at what probable time in the future will timber be opened up.

Present cost of marketing timber from the area (in detail).

Relative amounts and accessibility of private timber holdings and influence on present and future demand for forest timber.

Timber which should be sold for the good of the forest :—

Special bodies of overmature timber.

" " " dead "

" " " diseased "

" " " insect-infested "

(Show on forest map. Give approximate estimate and briefly describe condition and possibilities of early disposal of such timber.)

PART IV.

Regulation.—

Special needs of forest timber now and in the future—

By settlers.

By near-by communities.

By whole State or region.

On basis of above, show in detail on map of forest whether—

1. Ordinary sales are desirable
2. Small local sales only.
3. Free use only.
4. Protection (Watershed Protection) forest

(Use following colours.)

1. Dark green.
2. Light green.
3. Yellow.
4. Red.

Limitation of annual cut.

On basis of (*a*) present stand in each block, (*b*) the present and future demand for timber, and (*c*) the time required to make a second cut on a normal acre for each type (see growth tables), determine the maximum annual cut permissible in each block and for the whole forest.

Stumpage prices.

Minimum rates for all species and classes of materials. By blocks if advisable. Differentiate live and dead timber. (If advisable, recommend a commercial and a non-commercial schedule of prices.)

PART V.

Management.—

Object of Management.—Should aim be to grow saw-timber tie-timber, mining timber, or other special classes of material. Silvicultural policy to be pursued. The kind of forest desired.

System of Marking.—Special modifications of General Marking Rules recommended.

Brush Disposal—Recommendations.

Fire Protection—Recommendations

Restriction of Grazing.—Recommendations.

Miscellaneous.

PART VI.

Grazing.—

Condition of the range.—Whether the young forest growth has been damaged by live stock, whether the grasses have been tramped out by overgrazing, or whether there is serious erosion of the soil.

Available water supply.—The distribution of water on the range. Possibilities of improvement in water-supply.

Kinds of forage.—The species of grasses, plants, and browse. Changes in species caused by overgrazing or climatic conditions.

Poisonous plants. Locations of areas. Period during which losses of stock occur.

APPENDIX.

Maps and Tables.

- Stand and Type.
  - Block and Type Map of Forest.
  - Block and Policy Map of Forest.
  - Detailed Township Maps.
  - Sectional Reports.
- Volume and Growth Tables.
- List of species.

A simpler outline was adopted for the second class of Reconnaissance studies since they are less intensive:

OUTLINES FOR RECONNAISSANCE STUDIES OF NATIONAL FORESTS.

(To determine the best way of handling the Timber Resources on each Forest.)

I. Divide the forest into blocks—that is, according to Watersheds and Natural Logging Units. Show these on the map of the forest.

(*a*) Within each block show (also on map, with different colors)—the various forest types, according to broad, natural divisions which can be easily recognised in the field. Describe briefly the characteristic stand in each type, the age, size and condition of the trees, whether mature or overmature, the presence or absence of young growth (poles and saplings), and of reproduction (seedlings, etc.) Give the estimated stand of an average acre for each type.

(*b*) *Total estimate* for each block, according to types and species. *Differentiate between live and dead, and between saw-timber and cordwood. If timber were sold, what per cent of the estimated stand could be cut without detriment to the forest? Area of merchantable timber in each block.

(*c*) Burns and cut-over areas in forests and immediately adjoining. Describe briefly and give acreage. Are the areas satisfactorily restocked? Show areas on map by means of double hatching for burns, single for cut-over lands.

II. Discuss the accessibility of the timber in each block. Whether accessible now or not. By what means it will be opened up and at what probable time in the future. The present cost of marketing timber from the area. The relative amounts and

* Tabulate estimate in detail by sections (if surveyed) and by watersheds, totalling for each block.

accessibility of private timber holdings and influence on the demand for forest timber now and in the future.

III. Special bodies of overmature, dead, diseased, or insect-infested *timber which should be sold for the good of the forest* as soon as possible. Indicate on map used under IV (see below) and give approximate estimate together with brief description and possibility of disposing of such timber.

IV. *Regulation of Sales.* Special needs of forest timber by settlers, near-by communities, or the whole State or region, now and in the future. In other words: (1) Are ordinary timber sales desirable? (2) Small local sales only? (3) Should the forest or any certain part of it be restricted to free use; or (4) is it merely a protection (watershed protection) forest? These points may be shown graphically on the forest map by the following colours (use a different map from the one on which types and burns and cut-over areas are shown):—

For (1) Dark green.
For (2) Light green.
For (3) Yellow.
For (4) Red.

V. Bearing in mind (*a*) present stand, (*b*) the present and future demand for timber, and (*c*) the time required to obtain a second cut on sale areas, fix an *approximate limitation of annual cut*, if advisable for each block. The cut should never exceed the producing capacity of the forest. A conservative policy is advisable. Recommend definite minimum stumpage prices to be obtained for the different classes of material and species. This should include dead timber. Commercial and non-commercial schedule of prices (if necessary)

VI. *Object of Management.*—Should aim be to grow saw-timber, tie-timber, mining-timber, or other special classes of material? Decide this from consideration of present and future demand for various kinds of timber in various localities What silvicultural policy should be pursued? What system of marking* is

* See general marking rules for forests

recommended to secure this object? Selection system, strip, etc. Marking with view to improving the stand, getting an early second cut, etc.

VII. *Miscellaneous Points.* —Fire protection. Restriction of grazing."

From the foregoing outlines it will be seen that they are somewhat similar to working-plans used in other countries. The method of estimating, however, and of determining the annual cut is radically different. Instead of actually measuring trees, it was necessary to adopt an entirely new scheme. Since sufficiently rapid progress could not be made by using a strip system even if the calipering were omitted, an occular estimate of some sort was necessary. An experienced man was secured, who could estimate occularly the stand on any tract of land within 10 or 15 per cent of what it would eventually cut out. The main basis for working-plans is secured, therefore, by a highly trained man walking rapidly through certain tracts of land and judging how many board feet they contain. To start with it is probable that Von Mantels' method will be used in determining the actual cut, but plans have already been made for measuring sample plots *on a broad basis* to determine the actual growth under varying conditions. For example, a tract of, say, one thousand acres that has been cut over on a timber sale is completely measured and the boundaries definitely marked; five or ten years from now this tract will be remeasured and the annual growth determined and classified for different qualities of soil and species. Already some 5,000 acres have been measured in this district, and it is probable that sample plots aggregating 100,000 acres will eventually be under detailed observation. The closest co operation will be maintained between the Office of Silviculture that has charge of the working-plans and the other executive offices, in order to make use of their detailed knowledge.

It is probable that working-plans will be revised annually instead of every five or ten years, as is done in other countries. Rapidly changing conditions makes this absolutely essential to success. The Manual of Procedure at present provides for an

annual revision of all estimates, an annual revision of minimum stumpage rates and of general marking rules.

A very important part of the work of silviculture is co-operation with Indian Reservations and private individuals in the study and proper management of their land.

As you can see by the organisation given in the first part of this article, planting is at present a distinct section and detailed plans are being prepared for all forests to show what species should be used, when and how the yearly planting should be done. Where working-plans are being made, this, of course, may be embodied in the plan.

The section of silvics has to do with the purely scientific side of forestry and already an experiment station is established that will conduct scientific tree and stand studies, meteorological observations, run off and ground water measurements. This is something that I am sure you will agree with me is urgently needed in every province in British India, and until it is secured technical Forestry in India will be sacrificed to the purely practical side. There will be eventually established other experiment stations not only in each district of the United States but probably several in each district. At present the section of silvics supervises not only experiment stations but measurements of cut over areas and all regional or tree studies. As rapidly as possible detailed investigations are being made of each tree of commercial value, both for planting purposes and for timber sale purposes. The leaflets published aim to be concise and are available for general distribution to the public.

It is realised that this article can only give Indian Foresters a mere glimpse of the work in this country, yet I am sure that many will be surprised at the rapid advance; ten years from now it is to be urgently hoped that Forestry in America can compare more favourably with the older countries.

The greatest criticisms of the American Forest Service at present are: first, low salaries and lack of technically trained men; second, increase in "red tape" and office routine to the exclusion of a requisite proportion of field work; third, the lack of

an official technical training school for the subordinate force. As to the Indian Service, the writer feels that lack of scientific experiment stations run on a practical basis for solving every-day problems and lack of general publications are wants that will eventually be supplied. American Foresters, however, will always envy the efficient fire-protection and remarkably practical administration that makes the Indian Forest Service pre-eminent in these respects.

T. SALISBURY WOOLSEY, JR.

SOME NOTES OF A TOUR IN CEYLON.

The island of Ceylon comprises an area of about 25,500 square miles, some five-sixths of that of Ireland. Its extreme length is 270 miles, its greatest breadth 140 and the larger portion is flat or gently undulating, though towards the south and west there is a distinct mountain region commencing at from 25 to 50 miles from the coast and rising to an extreme elevation of 8,300 feet above sea-level. This region extends over some 4,000 square miles and consists of a series of ridges having a general direction from south-east to north-west the ascent to the west being especially precipitous.

The seasons are marked not so much by changes in temperature as in a difference between wet and dry; the north-east monsoon blows from October to March and the south-west from April till September, and during either season the wind at sea-level is seldom of serious violence. But as the mountain ranges cross the monsoon currents practically at right angles, it follows that the rainy season on the east side of the island occurs during the north-east monsoon and on the western side during the remainder of the year, the dry seasons alternating in like manner The annual rainfall varies between 150 inches at Ratnapura and 46 inches at Jaffna and the mean temperature throughout the island save where modified by elevation, between 79° and 82°; in the

greater part of the island the degree of moisture in the air is from 75 to 85 per cent.

It will be evident from the above extremely concise description that the visitor to Ceylon finds himself in a land of evergreen vegetation where both forests and cultivated crops grow with amazing rapidity, though a distinction in the amount and incidence of the rainfall justifies a local classification in to the dry and wet "low countries" and the "mountain region" As regards cultivation only about one-fifth of the island area is devoted to this industry and this chiefly in the extreme north and in the west, south and centre while the rest of the land is mainly covered with forest. Of cultivated products rice is grown over the largest area, but even so the yield is insufficient for the demands of the population and large quantities of this grain are imported from India; cocoanuts and cinnamon are also of importance, the exports of these two articles amounting to about 26 lakhs of rupees, but the so-called "new products" such as tea with an export value of Rs. 62 lakhs, cocoa, rubber, citronelles, etc., are those on which, since the annihilation of the coffee and cinchona industries, Ceylon is to a great extent dependent for its prosperity.

From what has been above noted it might be expected that the forest area, the property of the State, brought in Ceylon a large revenue to the public treasuries, but this is not the case. The total revenue in 1907 from this source including the value of book transfers and of free grants amounted to about Rs. 8,16,000 against an expenditure of Rs. 2,80,000, and this is explained when we find that there are at present only 910 square miles of reserves and 2,810 square miles of proposed reserves in which the Forest Department has or wil have in the immediate future complete control though its duties extend over much larger areas especially in the reporting on and valuation of crown lands for sale. The proportion of permanent State forests here indicated is obviously too small in a country where the habits of the population and the interests of the planters both tend to the denudation of the surface soil, and it is to be hoped that the present figures are not final, though they certainly represent an immense advance if compared with the

statistics of even a few years ago. The difficulties in the way of effective forest conservation may be inferred from the following short restrospective notice of forestry in Ceylon.

The necessity for the better regulation of forest management in the Colony was apparently first acknowledged in the early eighties when Mr. Vincent of the Indian Forest Service was deputed to inspect and presented a most able and exhaustive report in 1883. This opinion appeared to be, and this has not subsequently been refuted, that these forests which then contained large timber were practically remnants of the primeval forests which once covered the island, whereas the inferior growth of to-day which occupies so large an area is the secondary crop induced by the practice of shifting cultivation which entirely changes the original character of an evergreen forest vegetation. It is asserted, and doubtless with absolute accuracy, that in no country is to be found so large a stretch of continuous shifting cultivation as in Ceylon, and the change in passing from the storeyed evergreen forest with its huge stems to the comparatively low scrub which now covers most of the accessible land in the island is too marked not to attract immediate attention.

The destruction of the State forests by shifting cultivation was in the past still further emphasised by the diminution of its areas by the sale of the best portions at mere nominal prices, generally much less than the value of the standing timbers, and this without reference to climatic or economic considerations. And in the unsold area, while no sylvicultural improvement was possible with the existing staff or under the then system of management the permit system, payment in kind, competition between adjoining districts, forced sales of timber from depôt, and a want of control of produce in transit were all influences which were destructive, not only to the improvement of the forest and its revenues, but actually to the forest capital.

Since 1883 efforts to organise forest management in Ceylon have been frequent if spasmodic, thus a Forest Ordinance was passed in 1885, the post of Conservator was reserved for an officer of Indian forest experience and a few Foresters were sent to study at the Dehra Dun Forest College, yet though some improvements

were introduced both in finance and discipline the system of dual control of the State forests and of their revenue by the Government agents, or District Officers as they are called in India, as well as the Forest Officer prevented any success in the attempt to radically improve forest administration by the elimination of abuses and the introduction of protection and sylviculture. In 1898 "a General Forest Administration" was constituted which through the Conservator and his assistants exercised full control over the more valuable forest areas, while a "Provincial Forest Administration" supervised through the Government agent the less important areas in which the Conservator had only advisory powers. This was a step which inevitably, though perhaps unwittingly, foreshadowed the complete severance of revenue and technical forest work and at once permitted the classification of forests and even prepared the way for the introduction of elementary scientific principles in their working had not an inefficient and inadequate staff prohibited even such progress as might have otherwise been anticipated. This system, however, could not be maintained. In 1905 the dual control which had in practice completely disassociated the forest and revenue authorities as regards State forestry was abolished; all forest management was vested in the Conservator and his assistants, the latter remaining, as in India, subordinate to the Government agents in all but technical matters; six Forest Divisions were formed and steps were taken to reorganise the establishment so that it could be recruited by trained officers.

With regard to this reorganisation the following interesting details may be noted. The Ceylon forest staff of the past and present compare as follows:—

	Prior to 1st Jany. 1905.		After 1st Jany. 1905.			In 1908.		
		Rs.		Rs.	Rs.			£
Asst. Consvrs.	1 on	7,000 p. a.	1 on	7,000 to	8,000 p. a.	2	Dy Consvrs.	750 to 900 p. a.
,, ,,	1 ,,	6,000 ,,	1 ,,	6,000 ,,	8,000 ,,	2	,, ,,	600 ,, 700 ,,
,, ,,	2 ,,	5,000 ,,	1 ,,	6,000 ,,	7,000 ,,	4	Asst. ,,	400 ,, 500 ,,
,, ,,	3 ,,	4,500 ,,	1 ,,	5,000 ,,	7,000 ,,	3	,, ,,	300 ,, 350
,, ,,	1 ,,	3,000 ,,	2 ,,	4,000 ,,	4,500			
			[illegible] ,,	3,500				
,, ,,	1 ,,	2,000 ,,	1 ,,	3,000				
Total	9		9			11		

The change from rupee to sterling salaries in the new scale will be noticed; this scale however is designed for recruits who have followed the training provided in Europe for entrants to the Indian Forest Service.' Local appointments of Deputy and Assistant Conservators, provided these have received a technical training in India, receive the following emoluments, *viz.* :—

Rs. 7,000	to	Rs. 8,000.
„ 6,000	„	8,000.
„ 5,000	„	7,000.
„ 4,000	„	5,000.
„ 3,000	„	4,000.

In the former case Assistant Conservators are granted annual increments of £25 until promotions by selection into the Deputy class when the yearly increment is doubled. In the latter case the Rs. 4,000 grade is entered after passing the language tests, and the Rs. 5,000 grade with increments of Rs. 500 after completed intervals of three years, while entry to the Deputy Conservator's class carrying with it annual increments of Rs. 50 is by selection. Local officers can however enter the sterling scale of salaries if they undergo a course of nine months' training in Europe.

The subordinate executive staff consists of 10 Foresters on Rs. 1,800 to Rs. 3,000, 40 Rangers on Rs. 500 to Rs. 1,500 and 102 Guards on Rs. 180 to Rs. 360. The rates quoted for Foresters and Rangers apply to trained officers; for locally appointed untrained men the rates vary between Rs. 300 and Rs. 2 000. It is not quite understood why in Ceylon Foresters should be a superior class to Rangers unless it was hoped in former days to introduce some novelty into the nomenclature, but the principle of granting superior emoluments to the more valuable recruit is most commendable and will surely prove effective, for the acquisition of knowledge is stimulated when it is known that a fair price will be paid for it. It was most annoying to realise that this reorganisation which has so vastly improved the prospects of Forest Officers in Ceylon was received, without universal approbation, in fact with a certain amount of adverse criticism by some of the beneficiaries, but the Conservator, Mr. T. J. Campbell, who

is practically responsible not only for the reorganisations of 1905 and 1908 but also for the enactment of the Forest Ordinance (No. 16 of 1909) which places State forestry on a satisfactory legal basis, who has been for the first time successful in the face of immense difficulties in organising forestry management in Ceylon, and who has the entire confidence of his Government, may be well content to abide by the verdict of the future which will be unbiassed by personal feelings.

The subject of the exploitation of the Ceylon forest bristles with practical difficulties. It will be inferred from the preceding remarks that some time must elapse before the full advantage of the recently introduced improvements in organisation can be felt. By degrees rules for general guidance will be issued and the necessary codes compiled, but as in the past no fire-protection has been attempted though in the drier parts of the island this is undoubtedly a necessity, as sylvicultural operations have been disregarded, as forest offences have been too frequent, it is evident that though much is being now done to aid in the work of other Government departments, there is an immense field of work open to the Forest Officer when he shall have leisure from reporting in "kumri" areas and in the sale of crown lands. It is not too much to hope that as climatic considerations have received attention in the prohibition of forest clearances above 5,000 feet (a far from drastic rule), so in the future more attention than is at present possible may be paid to the reboisement of "kumri" areas and more stringent rules introduced in order to prevent denudation even in private lands. The rivers of Ceylon run silt-laden to the sea, and though the cultivation of new products in vertical rows on the hillside may be more immediately economical, yet later on it will be found that more circumspection must be used if the fertile soil on which the prosperity of the island depends is to be maintained. Meanwhile the Department has to deal with forests from which the best has been removed and with a timber market that has been glutted with valuable timber. The former prices for satin wood and ebony are no longer obtainable and the Forest Officer has the task of again building up the export trade as well as of supplying

the home market with such timber as is required. The demand in railway fuel and a portion of the sleepers required is already met by him, and as no working-plans have yet been compiled, as demarcation is not complete, as improvement fellings are not yet possible, he has to fall back on selection fellings under the permit system, doing his best so that sylviculturally good may follow to the forest growth and financially that the abuses which characterised this system in the past may not continue. A reference to the Schedule of Royalties published immediately after the Enactment of Ordinance No. 16 of 1908 shows that 550 species of trees are marketable and that these are divided into eleven classes, permits being issued at rates varying from Rs. 2 to 10 cents per c.ft. Satin wood stands alone in class I and permits are not issued for ebony. At Re. 1 per c.ft. come amongst others *Berrya Ammonilla*, *Vitex altissima*, jack wood and teak; at annas 12 per c.ft. *Terminalia Chebula* and *Mimusops sp.* from which sleepers are cut, lower down in the scale *jaman* and *mohwa*, while *Pterocarpus Marsupium* is classed with *Heritiera* and *Albizzia* and *Anogeissus latifolia* with the *kusamb* till the *Sterculias* and figs are valued at almost a nominal royalty. Bamboos are not common in the Ceylon forests, but it may be noted that the seeds of *T. Chebula* pay a royalty of Rs 10 a ton and of *T. belerica* of Rs. 8, while those of *Kokoona zeylanica* are listed at Rs. 50 per bushel and the bark of the same at Rs 560 per ton. Timber and fuel during the past year realised about 2¼ lakhs of rupees of which about Rs. 1,30,000 were due to departmental operations.

In the very few days at my disposal I was of course able to see but little of the Ceylon forests and of their working. I should have seen insufficient even to remove erroneous impressions had it not been for the kindness of the Conservator who placed a Government motor-car at my disposal and though himself unfortunately unable to accompany me deputed Mr. Turner, Assistant Conservator, to fill his place and supply the local information without which our trip would have lost much of its value. From the conversations I had the advantage of having with the Conservator at his headquarters, I learnt much more than there is space to

set down in these notes, and left convinced that now so good a commencement has been made in Ceylon forest organisation a great future is before the Department, which up till a few years ago was not permitted the scope without which progress is impossible. For my part I am grateful for an instructive tour made all the more enjoyable by the hearty welcome I received and by the knowledge I acquired of the difficulties of our neighbouring brother officers and of the success with which they are being overcome.

S. EARDLEY-WILMOT.

NOTES ON THE EMPLOYMENT OF THE CHENCHUS, A JUNGLE TRIBE INHABITING THE NALLAMALAIS FOREST OF THE KURNOOL DISTRICT, MADRAS PRESIDENCY.

The Kurnool district lies in the centre of the Peninsula to the south of Hyderabad. It lies in the centre of the famine tract and is a dry district with an average rainfall of about 26". In the forests which form the subject of this note it is considerably more, but rain-gauges have been too recently started to give accurate average figures If the district figures of rainfall taken at recording stations in the towns show an average of 26," the average for the Nallamalais would be about 40", and in parts more

The Nallamalais forests stretch from the Kistna river on the north to the Cuddapah district boundary on the south, and lie between the meridians of 78° 23′ and 79° 36′ east longitude. Including the Terai portions the area amounts to 1,269,853 acres or 1,984 square miles. Until July 1904 all this area of forest was included in the Kurnool district forest charge, besides which were other forests, which brought up the total area of reserved forests in the district to about 2,700 square miles.

On 1st July 1904 the forests were divided into two charges the dividing line being the taluk boundaries on the top of the Nallamalais. A further division of the district into three is now under contemplation.

The Nallamalais form a very undulating plateau traversed by a north and south system of elevations and depressions. The highest point is 3,100 feet above the sea-level, and the average elevation may be taken at 1,700 feet descending to about 900 feet in the Terai.

This rapid alternative of hill and dale renders exploitation of many parts of the forest very difficult. These difficulties are now being overcome as an Extra Deputy Conservator, with a special staff was appointed, some two years back, for roads and buildings on the hills.

Few of the streams are perennial, and those that are, soon dry up after leaving the hills. The main supply of water is received from the south-west monsoon, which gives the western slopes a greater rainfall than the eastern. The north-east monsoon brings less rain than the south-west, and in its turn benefits the eastern side of the hills to a greater extent than the western. The density of stocking is thus greater on the western side, where the springs are more numerous.

The forests have been annually devastated by fires, mainly caused by this jungle tribe, the Chenchus, who inhabit the forest. Until the last few years no serious effort to deal with the fires had been made. These Chenchus, who number in all about 4,000, have the right to live in the forest and to collect minor produce, subject to the right on the part of Government of pre-emption of the

produce from them This minor produce consists of *Bassia* kernels and flowers, myrabolams, *Pongamia glabra* kernels, honey wax, tamarind, fruits, etc. Taken alone this was a very precarious source of livelihood, as a good crop only comes once in a few years, They supplemented this source of income by working to some extent for timber, and bamboo contractors, and by stealing a great deal of timber, mainly spokes and felloes of *Pterocarpus Marsupium*, which they would smuggle into the villages at night. During the time of crops in the villages outside the forest, they would be employed by the ryots in watching their crops at night, failing which they would loot the grain. Altogether they had a poor time, and got a very bad name, at times resorting to murder. Like all jungle tribes, edible roots formed a considerable part of their menu.

They are a tribe somewhat low in the scale of humanity, as they do no cultivation beyond a very small patch of Indian corn. Prior to Government taking up the right of pre-emption of minor produce, they dealt with *sowcars* for the disposal of their collections, under a system of advances and were always swindled, the *sowcars* keeping no accounts

They fire the forests for the same reasons as other such tribes do, *viz.*, to move about freely, for shikar, for collecting mowha flowers easily and other minor produce, by carrying torches, etc. They burn trees to smoke out iguanas and leave fires kindled to cook them and anything else that they shoot.

At the time the mowha flowers they get very drunk and become very unmanageable, and so the forest suffered by being burnt.

Prior to July 1904 with Settlement still in hand in this large charge, little could be done to reform this jungle tribe or to deal effectively with fire protection. The permit system unregulated, except so far that for some years the removal of the better species of timber on permit had been prohibited, was in force. This unregulated permit system had resulted in the forest being denuded of most of the good timber and rendered very open, so that grass grew luxuriantly. Fires started by Chenchus would burn

unhindered for days and weeks over immense areas. The time of the flowering of the mowha coming when the forest is driest, and when there is a daily inrush of wind into this hot dry region from the coast, renders the forest an easy victim to many and extensive fires, which kill off the young seedlings and prevent regeneration. The forest had, therefore, in 1904 come to a very critical state as the existing crop was mostly injured by successive fires and was annually becoming thinner, big trees having their bases burnt through and falling. This was specially noticed after the long dry season due to the failure of the south-west monsoon of 1907.

When the district was divided into two in 1904, and as Settlement was nearly complete the District Forest Officer had for the first time leisure to take the questions of fire protection and the Chenchus in hand. It was evident that no schemes of fire protection could be effective unless these Chenchus could be brought under control and their good-will gained The first thing to do was to get rid of the *sowcars*. The right of pre emption of minor produce was taken up, and the result has shown what a small income this could have brought to the Chenchus as a source of livelihood. Other methods of employing them were then considered. It was necessary to find work that would be continuous and congenial to them, the whole year round. They required work at their villages, or gudems, and refused to do fuel or regular bamboo works at a distance. As however each village, with a few exceptions, was situated at a permanent source of water in the forest at the foot of the hills, it was decided to employ them on plantations. Such works would give them work the whole year round at their homes. In such a rigorous climate, in spite of 40" of rain, which however falls in a comparative short period of the year, it is necessary to water plants frequently to establish them.

This plantation work is thus a special undertaking made to employ a jungle tribe who have a right to live in the forests, in the hopes that in time they will become sufficiently reformed to give up firing the forests. Without such employment, fire protection would be impossible. These plantations are no doubt expensive, they work out to about Rs. 200—250 an acre, but the

expenditure is nothing in comparison with the gain of successfully fire protecting this immense area of forest. The plantations will be of great value of themselves, and will be practically fire proof after a canopy is established. They will contain little or no grass, which comes to the same thing.

I would mention that prior to July 1904 the Nallamalais forests in this, the west division, were divided into three ranges. Now there are six, two of which are plateau ranges. In the three northern ranges below the plateau ranges, there lies the Terai forest at the foot of the hills. For this Terai forest a Working Plan has been made in which seven of these plantations are included. This Working Plan provides for considerable departmental fuel, and bamboo operations, improvement fellings for small timber over a square mile in each of the three ranges, fire protection, collection of minor produce, building and improvement of water-supply for cattle besides these plantations, so the Range Officers have a very busy time. As regards the hills no cutting is allowed and only dead timber is removed pending the advance of fire protection.

I will now give a brief description of the work in the plantations in the west district.

The first is at a place by name Nagaluti. Here a perennial stream issues from a deep gorge in the hills where there is a dilapidated temple. This stream water used to disappear into the ground after running a very little way, but by blocking the old stream bed, the water has since been traversed into channels for irrigating seedlings. The country slopes gently westwards; work was started in November 1905 with the clearing of heavy bamboo growth, all the straight poles of superior species being left. At present 88 acres have been established, and 35—40 more will be planted as soon as the next monsoon commences, 1909. The climate is so severe on seedlings that they cannot be left long without water at first. The monsoon is spasmodic, several inches of rain may fall in few days and then there may be a gap without any. It was found that transplanting direct resulted in a large percentage of casualties, so seedlings grown in beds are transplanted into baskets on wet days and later

into the ground. Large numbers of seedlings are raised in bamboo pots, which is a cheaper method, such pots being easily transported without disturbing the roots, and a supply of plants can be kept all the year round. The soil is deep and rich, being formed of earth washed down from the hills The species planted are (1) Teak which is indigenous in the forest, (2) *Pterocarpus Marsupium*, in great demand for spokes and felloes, (3) *Terminalia tomentosa*, (4) *Albizzia odoratissima*, (5) *Dalbergia latifolia*, (6) *Diospyros ebenum*, etc., and mahogany too, whenever seeds are obtainable.

Where the stream enters the plantation area the leading teak planted in June 1906 are well over 30 feet, but only those which are near the constant flow of water have obtained such dimensions. Plants are put out 6′ × 6′ and it is sufficient if 75 per cent. of these get established by the end of the next hot weather.

The growth of grass on such rich soil is very great. The women keep clear the area which is planted during the year. The grass in the areas planted previously has to be cleared in October-November by outside coolies as a fire protection measure until a canopy is formed. These areas cost so much to establish that they can be allowed to run no risks of fire. It is not an ordinary risk that they run for, if in any way for any petty reason one of these creatures of the forest considers himself aggrieved, he fires the forest without the slightest compunction. The seedlings are planted according to species in plots of 20 × 20 yards, in order to give an even mixture in course of time.

In order to keep the Chenchus in the forest, shops have been established at each plantation in which the usual food-stuffs and clothes are sold at cost price. Clothes are given in advance, the cost being recovered at four annas a week.

The plantation is in charge of a Deputy Ranger who has a supervisor and gardener to assist him. Each Chenchu is paid 4 annas a day, each woman two annas six pies, and each boy two annas. The men are expected to work 8 hours a day and the women and children 6.

The Deputy Ranger has a pukka-built combined dwelling house and shop. Before this was constructed it was found that the

wall of the temporary shop made of bamboo and mud was, from time to time, cut through in the night and some of the shop stock extracted.

These Chenchus have behaved fairly well since they have been employed, but on one occasion in the mowha season an old ruffian who had imbibed too freely, tried to shoot the supervisor with an arrow. On another occasion one who was also in the same condition, came to me complaining that his enemy had given him and his wife a beating. He said "I know the law, but if you will give me permission in writing I will go after him with my bow and arrow". They are paid every Sunday morning, but instead of actually receiving the cash which would mostly be spent in the nearest toddy shop outside the forest, the money is transferred to the shop and an equivalent in food-stuff given according to the wish of each individual.

The next plantation is three miles off, the source of water being a built up-spring which only overflows in the south-west monsoon. As the area of good soil suitable for planting is limited, only twenty men and twenty women can be employed daily. The balance of Chenchus going and returning daily to the above mentioned plantation at Nagaluty. The water is raised from the spring by a picottan and run in long lengths of open wooden troughs made from soft trees hollowed out, until it reaches the ground where it flows into a large earthen tub from which it is taken in pots to the plants around. When these are watered, two men lift the water into another set of troughs, and so on. The procedure is otherwise the same as already described.

The next plantation is seven miles to the south in the next range. The source of water being a copious spring which comes up through deep rich black soil, specially favourable for the growth of *Albizzia procera* and *odoratissima*. When the work was started plants were mixed and not put in groups, with the result that one can now walk under a canopy of *Albizzia* with the teak trying to keep pace and with an undergrowth of *Terminalia tomentosa* and *Pterocarpus Marsupium*. The water flows in a deep stream bed so that since the work was started all the watering has had to be

by pots. There are about 50 acres of this deep soil in the immediate vicinity of the spring, all of which will have been planted by the end of June next. Just beyond this the rock comes to the surface and the water flows without banks. A little further on it disappears in a deep stream bed. A simple masonry dam will enable us to take this good supply of water to the north and south of the old stream bed for some miles, to areas suitable for planting.

There are some very unruly spirits in this gudem. One of their number is an outlaw having killed another Chenchu in a brawl. He comes at night time to the village for food but can never be caught. The forest is always, in the dry season, in danger of being fired by him, the only hope being that he may think that the grass may give him more concealment. The Deputy Rangers in charge have on several occasions suffered assault during the mowha season. One once reported "They twisted me into all sorts of shapes, but, thank God, they had not their bows and arrows with them or I should have been a dead man". One of them was prosecuted for these assaults and after doing six months in jail is said to have attended, on being released, one of the festivals at a temple in the forest further south. He is said to have secured sufficient loot on this occasion to purchase twelve she-buffaloes, so now he is a rich man.

The next plantation is three miles further south, where the source of water is a built-up spring which gives a copious stream of water all the year round. The soil is a deep rich dark loam, with the ground sloping to the west as usual. Several hundred mahogany have been planted here with the other species previously mentioned, and are doing very well, about 50 acres have already been established which will develop into fine forest in course of time. The watering is done by channels. The water is let down to the end of the channel, and then a mud bund is set behind each plant in turn from the lower end, so that each plant secures a good supply of water.

Five miles further south, a stream comes down from the hills and runs in a long narrow valley meandering from one side to the other. Shortly after leaving the valley it disappears. The

valley which contains deep rich soil is being planted first. The work was started in June 1907 with clearing the area to be planted of bamboos and useless growth When the season for watching the ryots' crops arrived the Chenchus left in a body refusing even to leave a few of their number to water the seedlings in the nursery, so the work was closed. After the crops were harvested they found themselves badly off as compared with their fellows who were getting regular pay to the north and south of their gudem. They came to me and begged me to re-open their plantation. I pointed out to them how they had left me in the lurch without any consideration, and that I could not afford to keep starting plantations only for the plants to die, while they preferred the easy existence of watching crops and pilfering grain. I told them that if in three months' time they were sure that they really wanted to work regularly I would re-start the work. They went away but were back in three days begging me to let them have work again, so I commenced again. We borrowed four thousand plants in bamboo pots from the next plantation, and these were planted out in the area already cleared and watered through the hot weather. Since June '08 about forty acres more have been planted and regularly watered by pots. The valley being narrow and the stream winding from one side to the other, water has not to be carried far. A very fine piece of forest will be the result in time, the casualties are very few, in fact hardly any. When the valley has all been planted, the results will justify the purchase of a pump to send the water down below along the sloping Terai forest.

The next plantation is four miles further south. Here another stream comes down a rocky gorge, the entrance of which is quite narrow. The stream which gives a plentiful supply of water all the year round does not flow far in the hot weather. About forty acres have been established by pot watering, which is all that can be planted and watered by carrying the water to the plants. A masonry dam is now being constructed at the entrance to the gorge at a cost of Rs. 5,000. This will give us a stream of water with a section one foot square that can be trained over the sloping

ground westward for a very long way sufficient to give water for establishing a fine piece of forest during the next century.

The next plantation in the Terai forest is fifteen miles further south and is only a small one.

The last one is on the plateau ten miles to the east and above the first one mentioned. The source of water here is a tank with a bund just half a mile long. The water is distributed by means of wooden troughs already described. Next year we shall get some iron piping, as all the area immediately below the bund has been stocked. A short length of piping will place the water in a fresh planting area through which it can be distributed by wooden troughs. A fresh length of iron piping can be added when necessary, and thus the plantation can be extended over a large area.

During the fire season two Chenchus are employed as fire watchers at each gudem. They watch from a *machan* on a high tree and if a fire is seen they beat a tom-tom and all the gudems run out to put it out. Others are employed as patrols.

Having put them in the way of earning a decent livelihood, we have now taken up the question of trying to prevent their firing the forest in order to get mowha flowers easily. Wherever there are jungle tribes and this source of obtaining free liquor, I suppose the forests are fired. Nothing will prevent such people from getting free drink when they can get it without any risk, nor will any amount of asking such people not to burn the grass under the mowha trees keep them from doing it. It is so much easier to collect the flowers on a flat burnt surface than it is to pick them out from 5 or 6 feet of thick grass. It is impossible to prevent illicit distillation when the process is so simple and the forest area so large. Although the Abkari Department have tried to catch such distillers they have never succeeded. This being so, it seemed better to try and regulate matters. The following experiment has been sanctioned for a year on trial. The flowers will be collected by a selected gang under supervision, at each gudem The Chenchus employed will be given the ordinary plantation wages, and a high price will be paid for the flowers collected by

these gangs. The men will clear the grass under the trees and the women will collect the flowers. Two rupees per maund of 25lbs., less the wages of the gang, will be paid for the flowers. This money will be equally distributed amongst the members of each gudem at the end of the season if they have not fired the hills. A moderate amount of flowers will be given weekly during the flowering season only to each adult, who will be allowed to distil for his own consumption, not for export, without the Abkari officials interfering. In this way we hope to do away with this source of fire, which was hitherto always being effected by gangs secretly sent out from each gudem to collect and distil.

Finally, to make this note complete, I would add that the forests are gradually being brought under direct fire protection. In the Terai, wide fire lines 60 feet broad from which all roots and stumps have been extracted have been made. Guide lines about nine feet broad are cut and the grass placed in the centre. The uncut grass is beaten down and as soon as possible is burnt. On the hills the lines are a hundred feet broad. Some are ready but others still have to be cut. Further establishment is yet required, but we hope in time to establish efficient protection and to give seedlings a chance of growing up to form the future forest. What chance have they had in the past with a mass of flame often 50 feet high?

H. F. A. WOOD,
District Forest Officer,
West Kurnool.

KURNOOL:
Dated 22nd February 1909.

[We shall be very glad if other officers will inform us how they are dealing with jungle tribes who insist on burning forests.—HON. ED.]

REPRODUCTION OF TEAK IN BURMA

Teak is one of many species of timber trees which form a somewhat light overwood above a much denser canopy of bamboo, and being a light loving species its reproduction must be seriously affected by this undergrowth. In fact many well known forest officers have expressed an opinion, and in the older records it

seems to have been generally accepted, that *all* reproduction of teak is prevented. Bamboos, however, flower periodically and at such times the old crop dies and the canopy is temporarily removed, thus letting light on to the ground until a new crop springs up; and it has also been generally accepted that the supply of teak is entirely maintained by reproduction at such times. Now in the case of *Kyathaung* (*B. polymorpha*), a bamboo which covers hundreds of square miles of the finest teak forests on the Pegu Yomas, the flowering occurs gregariously—and never by single clumps and at very rare intervals at most once in fifty years since last general flowering occurred in 1852. This view can, therefore, be readily tested in these forests, as if there is no reproduction between the intervals of flowering, that is for a period of over fifty years, the reproduction of teak must be extraordinarily abundant, at such times in order to keep up the supply. Now there are records of a general flowering of this bamboo which occurred on the Pegu Yomas in 1852, and of another which occurred on the Arakan Yomas in 1891, yet in neither case was any mention made of any remarkable reproduction of teak.

Again, the result would have been that the existing crop of teak would be found in age stages, corresponding to past flowerings of bamboo, and these stages would be exceedingly distinct and the whole crop would only comprise five or six classes. If such age stages were found, constant reference would be made to them, and by felling one tree of each gradation and counting the annual rings, it would have been ascertained in what years former flowerings occurred, and in making enumerations, etc., arrangements would be made not to include trees of different classes. I do not think, however, that any one who has had to do with *Kyathaung* forests would seriously contend that teak is found in such age stages.

Again, it would follow that no teak would have sprung up since 1852, but in working plans for the *Kyathaung* forests the enumerations show that there is an enormous supply of "seedlings," which certainly means plants which have originated subsequent to 1852. There seems to be, therefore, no evidence that any reproduction of

teak is affected in the year in which the bamboo flowers, but ample evidence that sufficient reproduction takes place between the intervals of flowering. The fact seems to be that the bamboo canopy is not absolutely uninterrupted, and that in gaps made by falling trees, and often in spaces between the bamboo clumps, sufficient light is let on the ground for teak seedlings, which in their earlier stages stand a considerable degree of shade, to spring up.

We are carefully taught that the general principles of sylviculture are universal, and being saturated with a three years' course of the theory of Continental forests, we seem to think that when we come to Burma it is only necessary to apply these theories. Just as in the matter of agriculture in Australia, many of the early settlers, who considered themselves matter of fact, cool-headed, practical men, jeered at new fangled notions, failed miserably by adhering too closely to the method of a northern climate and by ignoring the difference in conditions, so we, I think, and our predecessors have taken it too much for granted that our theories are applicable in Burma. To obtain reproduction of teak it seemed only necessary to open out the cover, and the natural removal of the bamboo owing to the periodical flowering seemed, therefore, a favourable time to assist natural reproduction of teak; as a logical outcome of this view elaborate schemes were prepared of works to be undertaken when the next flowering might occur, and it was decided that, in the meantime, with the exception of forming taungya plantations, nothing could be done. During the course of years, however, experience has shown that facts do not always bear out the theories accepted in cooler climates, and we feel that our predecessors, in some matters, went further than we, in the light of subsequent experience, consider they were justified in doing, and we deplore the energy with which they acted on their convictions. We have learned not to be so hasty and rash, and are now extremely cautious. We seek safety in a middle course, and in matters of opinion we do not go far enough to please some of the younger generation, but too far for the more conservative, and our actions are influenced by the same spirit of caution and

compromise In this particular case, for instance, I do not think a single forest officer in the Province now believes that natural regeneration of teak is restricted to the time of the flowering of the bamboo, but instead of going into the matter more thoroughly and, if necessary, revising the schemes, it has been decided that they are to be carried out in their entirety, but to consider them "purely experimental." If the operations prove unsuccessful we can maintain that we did not predict otherwise, and that we have thereby obtained an invaluable store of useful information for future guidance, and we disguise the fact that we dispute some of the views of our predecessors and relieve ourselves of the unpleasant necessity of upsetting their plans. There is something royal in the idea of operating over the hundreds of square miles of *kyathaung* forests, to determine a small and elementary item of knowledge. It is magnificent but it is not Forestry A sylvicultural operation ought to be a safe investment, and the money spent ought to yield an adequate return owing to a corresponding improvement in the crop, but to say that a work is "experimental" is an admission that the result is not assured, and to spend large sums of money, as we propose to do at the next general flowering on works the result of which is uncertain, is reckless gambling. We seem to think that when we come to Burma we have nothing to learn—at least very little attempt seems to have been made to learn anything even about teak. No actual obstacles are put in the way of research, but it seems to be considered, like butterfly catching, a harmless hobby outside one's ordinary work, or at most a matter for specialists, instead of being actively encouraged and undertaken systematically. Perhaps some of us might admit, in the abstract, that a little knowledge is a dangerous thing, and that it is essential that our works to improve our forests should be based on accurate knowledge, but can any one mention any concrete case to show, either that any serious efforts have been made to collect reliable information, or that it would be difficult to do so. In this particular matter, for instance, it is necessary to determine whether reproduction of teak is affected entirely or partly—and if the latter, to what extent at the time when the bamboo covering is

Photo-Mecht. Dept., Thomason College, Roorkee. Photo. by Barrington Moore.

The Grazing Problem

Part of the same forest as in Plate 13 which was open to Grazing but has now been closed for 8 years, showing good reproduction coming on.

removed. The size of the girth indicates, roughly, the age and in doubtful cases the age can be determined accurately by felling the stem and by counting the annual rings. By careful enumerations of the growing stock, therefore, it would be possible to ascertain the relative abundance of stems which originated in 1852, that is in the year of the last general flowering, and also of seedlings which have sprung up subsequently. Similarly, numerous areas where species of bamboo other than *kyathaung* have flowered and died can frequently be found, so that it could be ascertained whether there is any remarkable abundance of reproduction at such times, and also any methods proposed for assisting teak could be thoroughly tested.

I believe that I am correct in saying that the proposal to spend large sums of money to assist reproduction of teak at the next general flowering of *kyathaung*, is based entirely on theoretical considerations, and it may be of interest to disregard the theories of what ought to be the result, and to attempt to ascertain what actually has been the result of such sowings. Patches of a hundred square miles or more are sometimes found where species other than *kyathaung* have flowered and died, and nearly every forest officer in the Province has, I believe, at some time or another attempted to sow teak in such areas, and I believe the result has been, with one or two exceptions about twenty years ago, a failure. I have myself at various times dibbled in teak seed in such areas, and more recently Mr. Collings and myself carried out this experiment in the Yaw division with great care, demarcating special sample plots and sowing the seed at stake, broadcast and accompanied with hoeing, and in every way we had heard advocated, but without success. This matter should, I think, be gone into really systematically, and if careful records were kept of every *wathon* sowing made, the result would, I think, soon be definitely determined.

Our forests contain many species, and many factors have to be taken into consideration. We find teak plentiful in one place and yet close by, although we cannot distinguish any difference in the conditions, teak may be entirely absent. I think it very

unwise, therefore, to attach much importance to isolated experiments. It may, however, perhaps be of interest to describe a few experiments and observations I have made, although, unless they can be corroborated, I do not think the results are of much value. It has been stated that when bamboos die they become dry and inflammable, and consequently it has been suggested that *wathon* (bamboo flowered) areas in fire-protected tracts should be deliberately burnt over to clear the ground before sowing teak seed. The following observations were recorded by Mr. Collings and myself from sample plots set aside for the purpose. The bamboo *Dendrocalamus strictus* flowered at the end of 1903, but during 1904, 1905 and 1906 practically no stems were destroyed. In 1907, however, the stems began to get rotten so that many were broken off, and in 1908 few were left, whole clumps being blown down. So long as the stems were standing and hard, they appeared almost impervious to the light leaf fires, but when they were blown down they became sodden and soft and were then destroyed by white ants during the rains or by fires in the hot weather. The dry stems were riddled by a small weevil and this doubtless made them so liable to be blown over. The bamboos were destroyed in about the same time both in the protected and unprotected areas, namely in about five years.

It has also been stated that by burning over a bamboo flowered area much of the bamboo seed would be destroyed, so that teak seed sown after the fire would have more chance. We noticed, however, that the bamboo regeneration was slightly more dense in the area not protected from fire.

We also wished to ascertain whether teak seedlings, sown at the same time that the bamboo seeded, could be kept clear of the new growth of the bamboo. We, therefore, made notes as to the growth of the latter. The bamboo seeded in 1903, but in 1904 and 1905 little new growth could be seen. In 1906 it became more apparent, and in 1907 it made great progress and averaged 3′ 3″ in height. Wherever the ground was open the bamboo was dense, but in places patches of an undergrowth called *Paungthaung* prevented its appearance. In the case of *Kyathaung* which

flowered on the Arakan Yomas, it was reported that the new crop attained a height of five to six feet in two years.

We found a number of teak seedlings which had originated before the bamboo had flowered but had been kept back by the shade. We marked several such seedlings and found that owing to the access of light, growth was extremely vigorous—about two or three feet a year—both in the protected and unprotected areas. In the latter, the vigorous growth enabled the seedling to withstand the annual fires until the fifth year when several whole clumps of bamboo were blown over, and on burning caused such a dense fire that several teak seedlings were burnt down. There is little doubt that a new shoot will be sent forth, but in the protected areas several teak seedlings were similarly burnt over and crushed by these fallen clumps, and there is little chance of their developing into straight and useful stems It is curious therefore that the advantage is with the seedlings in the unprotected area.

If natural regeneration is restricted to the year in which the bamboo flowers, one would expect *wathon* sowings to be successful, but if, on the other hand, regeneration takes place gradually between the intervals of flowering, one would expect successful results by dibbling teak seed in gaps and where the cover is less dense, and in fact in those sort of places where teak seedlings seem to spring up naturally. I have, however, only heard of one instance where this method was successful (in the Pyinmana division) although most of us have repeatedly sown seed in this manner and, I think, if evidence were systematically collected and compared it would prove that this method is unsuccessful.

I am inclined to attribute the cause of the failure of this and other methods of artificial sowings to the fact that teak is a bad germinator. Several facts, I think, support this opinion. In Europe one may sometimes find several hundred oak or beech seedlings in a few yards, but in Burma, however favourable the locality, it is rare to find more than 50 or 60 teak seedlings per acre. Moreover many of these may be of a considerable age Mr. Collings and I were passing through an area where the bamboo

had flowered about five years previously, and were struck by the abundance of teak reproduction which appeared to have originated at that time. As some of the seedlings had been burnt back, we dug up some of them and ascertained the age by counting the annual rings at the top of the tap root and found that the age varied considerably but that some of them were as much as fifty years old. If, therefore, there can only be found about 50 seedlings per area, and if some of these may have originated from stool or sucker shoots and the rest vary in age up to 50 years, the annual production must be exceedingly small. One can best realize this by trying to find one year old seedlings. Personally, I have hardly ever found one. The composition of the seed accounts to some extent for the difficulty of germination, as the embryo is very small and enclosed in a thick corky pericarp and no store of nutriment is provided. But although teak seed does not germinate readily, it seems to possess considerable vitality. I have, for instance, frequently noticed that more seed germinates in the second or third year after sowing than in the first year, and possibly it possesses the power of lying dormant for many years, until circumstances favourable to germination arise. The fact remains, however, that teak is very much more abundant than many other species of which the seed germinates more readily, and I think this is due partly to the fact that teak seed seldom seems to germinate except in places where a seedling has a good chance of thriving, and to the fact that the seedlings are exceedingly sturdy and, even if they make little progress, can bear considerable shade, and are immune to many other dangers.

We are, I think, very ignorant as to what conditions are favourable to germination. It has, however, often seemed to me that these favourable conditions occur in cycles. I have, for instance, noticed that in one area there may be many small seedlings but few saplings, and in another many saplings and few seedlings, and groups of trees often seem to be even aged. I am in fact inclined to think that there are factors, other than light and shade which have to be taken into consideration. It has been suggested that some plants excrete toxic matter, which renders

the soil unwholesome until the deleterious matter is removed by a rotation of another crop, but this theory dees not seem to explain the facts, as teak only forms a small proportion of the vegetation and a complete series of age gradations is generally found without a rotation of other species, and if toxic matter were excreted it would presumably be dissipated by the annual fires since fire is an oxidising agent.

It seems to me that if it is desired to obtain artificial repro duction, this might be possible by getting round the difficulty of germination. There seems to be no difficulty in getting teak to germinate in an area where the vegetation is cut down and the ground kept clear of weeds, as in a taungya plantation. A possible explanation may be that as the seed has a thick covering the heat of the sun may be necessary to stimulate the growth of the embryo, or that as no store of nutriment is provided abundance of light is required to enable the cotyledons or small leaves which first appear to derive nourishment from the atmosphere until the root is developed. As an experiment, therefore, Mr. Collings and I had a small nursery made in an open place near a fire watcher's hut on the banks of a stream, sowing the seed in the hot weather and watering it to obtain early germination. To avoid labour and expense, we transplanted the small seedlings soon after they appeared, before the tap-root had attained any size and as soon as the ground was sufficiently moist, so that they had practically the whole of the growing season to establish themselves against the hot weather. The seedlings were transplanted in gaps, etc., in the open forest. There has not yet been time to obtain reliable results but there seemed a fair prospect of success.

A description was given in the "Indian Forester" some years ago, of an experiment carried out by a Ranger in the Tharrawaddy division. Instead of sowing teak seed, he dug up pieces of teak root and planted them with good results. I have not tried this method but think the difficulty of germination might possibly be avoided in this manner.

It does not require much labour or expense to carry out experiments and observations. A Deputy Ranger can generally

be found competent to survey and demarcate sample plots, and the average forest guard is quite competent to mark and measure seedlings and trees of which the growth is to be noted, and it is only necessary to check the work carefully. The results would, however, be very reliable if, for instance, ten men carried out an experiment and obtained exactly the same result and if most divisional and sub-divisional officers consented to carry out a few experiments, and if their efforts were properly organized and the results systematised, we should soon accumulate a useful amount of information and be able to establish our sylviculture on a sounder basis.

H. C. WALKER.

April 1909.

SYLVICULTURAL NOTES ON HARDWICKIA BINATA.

1. I have lately been much struck with the large proportion of stumps of *Hardwickia binata* which die after felling, and in order to try and find out if this lamentable fact can be remedied, I have taken notes and measurements of the stumps of felled trees in coupes which have been worked during the last 14 years, and schedules A and B record the results: in ten of the coupes the measurements were taken by me or in my presence, in the other four coupes they were taken by a trained Forester, Mr. Deo, who was present when the measurements were taken by me in the ten coupes and who, therefore, thoroughly understood what was required.

2. The *Hardwickia binata* forests where these measurements were taken are in the Dhulia and Pimpalner Ranges of the West Khandesh Division of the Bombay Presidency; latitude 20° 50', longitude 74° 30', altitude 900' to 1,900': geological formation, Deccani trap. The rainfall is shown in statements A and B and works out to an average of 19½ inches per annum (18¼ inches per annum at Sakri and 21¼ inches per annum at Dhulia): the rain practically all falls between June 1st and November 1st, there is usually no south-east monsoon rain. I had wished to take all the measurements in one forest and was able to do so for the

fellings of ten years out of the 14, the measurements for these ten years being taken in the Mhasdi-Kalgaon forest 10 miles south-west of the rain-gauge station of Sakri: the measurements for the other four years were taken 15 to 20 miles east of Mhasdi-Kalgaon and from 6 to 1? miles south-west of the rain-gauge station of Dhulia. The forests are however all on the same range of hills and have practically similar locality factors.

3. Before taking these measurements I had thought that one or all of the following factors might have influenced the life of the stump, and the measurements were chiefly taken to ascertain if this was the case.

Factor 1.—The height at which the stump was left after felling.

Factor 2.—The age (circumference) of the stump.

Factor 3.—The rainfall of the rains immediately preceding and succeeding the felling.

4. *Factor* 1.—*The height of the stump.*—From schedule A, columns 4 to 10, we see that the height the stump is left after felling has nothing to do with the vitality of the stump, the percentage of live stumps classified according to their height above ground being very much the same, *viz.* :—

Height of stump.			Percentage of live stump.
2" or less	.	...	47
2" to 4"	...	...	46
4" to 6"	...	.	45
6" to 9"	...	...	47
9" to 12"	...	...	39
Over 12"	...	...	50
General percentage...		...	47

Factor 2.—The age of the stump.—From schedule B, columns 3 to 6, we see that the age of the stump also has nothing to do with its vitality, the percentage of live stumps classified according to their circumference being as follows :—

Circumference of stump.	Percentage of live stumps.
2′ or less	49
2′ to 4′	47
4′ to 6	41
Over 6′	45
General percentage... ...	47

Factor 3.—The influence of the rainfall. From the figures in schedule A, columns 2, 3 and 4, it appears that the rainfall has no effect on the vitality : thus the fellings of 1899-00 and 1907-08 were those which had the greatest deficiency of rain in the rains immediately preceding and succeeding the felling, and those of 1894 95 and 1896-97 had on the contrary the greatest sufficiency of rainfall. The figures for these four years are as follows :—

Year.		Rainfall, in inches of the monsoon immediately preceding and succeeding the felling.		Percentage of live stumps.	
Rainfall most deficient ...	1899-00	9, 14	Average 10 5, 11·5	68	Average. 53
	1907-08	12, 9		38	
Rainfall most sufficient ...	1894-95	23, 29	25, 30	73 ...	Average. 54
	1896 97	27, 31		36 ...	

The average percentage of live stumps of the most deficient and most sufficient rainfall years is therefore practically the same.

5. I am very surprised at the result of these measurements. Until they had been taken I was almost sure that as in the case of most trees so in the case of *Hardwickia binata* the age of the felled tree had a great deal to do with the vitality of the stump, and from casual observation in forest inspections I also thought that stumps "left high" were more certain to give coppice shoots than those cut level with the ground. These measurements however lead one to think that this is probably not the case.

These measurements cannot of course be taken as sufficient to prove that these three factors have no bearing on the vitality of the stumps even in the locality where the fellings took place, for only 877 stumps or an average of 62 stumps per coupe were measured; they do, however, conclusively show that in this locality less than 50 per cent of Anjan stumps survive the felling of the tree, and they also point to the *probability* of drought, height of stump and age of tree having little or nothing to do with the power of reproduction by coppice shoots.

6. The fact that, at any rate in the locality under consideration, more than half of the stumps of felled trees will die is a very serious one, and in this Division the result of not knowing or appreciating this has had an effect in many coupes which can be described as little less than disastrous, for when the fellings were undertaken during these 14 years it seems to have been taken for granted that the great majority of the stumps would put out coppice, and this not being the case blank after blank has been found, for not nearly enough standards were reserved. I mean to now remedy this by much closer standard reservation; but the outlook for the yield from the felled coupes in the second rotation is a very poor one, and what is of much more consequence the forest comprised by these coupes has been much damaged, as the density of the growing stock was far below normal even before the fellings took place. The lesson to be learnt therefore is to provide for heavy standard reservation in a working-plan for *Hardwickia binata* as coppice regeneration cannot be relied on.

7. A few more notes on *Hardwickia binata* may perhaps be of interest, and if any do not tally with the observations of

other officers who have had this tree under their care it would be interesting if they would contradict them.

Note (I).—It is hopeless to try and transplant the seedling, however young the seedling may be, artificial regeneration can therefore only be successful if sowing takes place where the tree is to be permanently. When sowing it is best not to cover the seed with soil at all, or at any rate to only partially cover it. The seed is useless unless sown in the year it falls from the tree.

Note (II).—The tree is a partial shade bearer, and what is more, unlike most trees, its seedlings do not mind grass even if the grass be 2 or 3 feet high. Weeding of grass in artificial sowings is therefore unnecessary: on the other hand the young shoots, whether seedling or coppice, are sensitive to fire, but the seedling roots will, after a forest fire, as a rule throw out new shoots.

Note (III).—Wind will blow the winged seed to a considerable distance. I have found a self-sown seedling over 40 yards from the nearest *Hardwickia* tree.

Note (IV).—Bushes of *Cassia auriculata, Gymnosporia montana* and *Rhus parvifolia* are of great use in regeneration: it is surprising how many healthy *Hardwickia* seedlings one finds right under the shade of such bushes: this is apparently due to the shelter afforded from the heat of the direct sun's rays and to the fact that under such bushes there is an accumulation of soil and humus, also where cattle grazing is allowed such bushes protect the seedlings from being eaten. I have not yet come to a conclusion as to whether such bushes should be cut level with the ground when the *Hardwickia* seedlings in their shade have attained a certain age.

Note (V).—Although Anjan often reproduces itself well by seed naturally still such repro duction is considerably helped and better ensured by breaking up the soil under a seedling tree; on such broken up soil the seedlings are not only more numerous but better grown, more vigorous and more likely to withstand the first hot weather than those on unbroken ground. Where the locality is suitable this breaking up can best be done by ploughing, otherwise by hand: the breaking up should be on the side opposite to

the direction from which the prevailing wind comes when the seed is falling; in this Presidency the breaking up should be to the north, north-east and east, the prevailing wind at that time varying between south and west. Where agriculture combined with forestry is out of the question artificial help in reproduction can best be given by throwing seed into the bushes mentioned in the last para. and by breaking up ground under seeding trees. As the tree does not seed annually the working-plan must lay down that in a seeding year such artificial help must be given in previous coupes felled in years when no seeding took place, as well as in the coupes worked in the seeding year.

Note (VI).—The tree can be artificially reproduced very successfully under the system of agriculture combined with forestry.

Note (VII).—The seedling remains bush like and only 6" to 18" high, for a period of four to seven years when a leader is put up and it goes ahead.

Note (VIII).—Coppice shoots are considered tit-bits by cattle and deer and hence great is the damage done by both in recently felled coupes: seedlings are also broused back.

Note (IX).—Schedule C gives some idea of the height and diameter growth of coppice shoots in West Khandesh and of the number of shoots one can expect per stump after the first year.

Note (X).—This tree is one of the best for thriving in poor soils: it will grow straight out of a rock if there be a crack in which the seed can fall and the roots get a hold.

L. S. OSMASTON

March 1909.

SCHE

Percentage of live and dead stumps with reference to

1	2	3		4		5	
Year of felling.	Rainfall in inches of the rains immediately preceding and following the felling.	Where rainfall was gauged and distance in miles of rain gauge from the felling.		TOTAL.		HEIGHT 2" OR LESS.	
				Live.	Dead.	Live.	Dead.
1894-95	23, 29	Dhulia ...	6	73 (51)	27 (19)	78 (7)	22 (2)
1895-96	13, 32	Sakri ...	10	50 (25)	50 (25)	100 (3)	..
1896-97	27, 31	Dhulia ...	8	36 (29)	64 (51	50 (5)	50 (5)
1897-98	21, 22	Sakri ...	10	48 (24)	52 (26)	...	..
1898-99	22, 10	Sakri ...	10	31 (21)	69 (47)	29 (2)	71 (5)
1899 1900	9, 14	Dhulia ...	8	68 (65)	32 (30)	69 (57)	31 (25)
1900-01	14, 19	Dhulia ...	12	44 (44)	56 (56)	43 (40)	57 (53)
1901-02	16, 23	Sakri ...	10	51 (26)	49 (25)	70 (7)	30 (3)
1902-03	23, 20	Sakri ..	10	38 (21)	62 (34)*	33 (9)	67 (18)
1903-04	20, 17	Sakri ...	10	52 (26)	48 (24)	47 (18)	53 (20)
1904-05	17, 14	Sakri ...	10	43 (22)	57 (29)	42 (16)	58 (22)
1905-06	14, 22	Sakri ...	10	31 (16)	69 (35)	28 (10)	72 (26)
1906-07	22, 12	Sakri ..	10	42 (22)	58 (31)	40 (17)	60 (25)
1907-08	12, 9	Sakri ...	10	38 (20)	62 (33)	38 (16)	62 (26)
For the fourteen coupes as a whole ...				47 (412)	53 (465)	47 (207)	53 (230)

DULE A.

height of stump and rainfall of year of felling.

6		7		8		9		10		11
HEIGHT 2' TO 4".		HEIGHT 4' TO 6'.		HEIGHT 6" TO 9".		HEIGHT 9" TO 12".		HEIGHT OVER 12".		REMARKS.
Live.	Dead.	Live.	Dead.	Live.	Dead	Live.	Dead.	Live.	Dead.	
86 (19)	14 (3)	76 (19)	24 (6)	62 (5)	38 (3)	33 (1)	67 (2)	...	100 (3)	In columns 4 to 10 the figures in brackets denote the number of stumps measured and the figures not in brackets denote the percentage.
32 (7)	68 (15)	60 (6)	40 (4)	60 (6)	40 (4)	50 (2)	50 (2)	100 (1)	.	
43 (10)	57 (13)	32 (8)	68 (17)	23 (3)	77 (10)	16 (1)	84 (5)	66 (2)	34 (1)	
37 (3)	63 (5)	37 (6)	63 (10)	65 (11)	35 (6)	37 (3)	63 (5)	100 (1)	...	
43 (6)	57 (8)	22 (5)	78 (18)	33 (5)	67 (10)	43 (3)	57 (4)	...	100 (2)	
33 (1)	67 (2)	71 (5)	29 (2)	100 (1)	...	100 (1)	...	...	100 (1)	
100 (2)	...		...	33 (1)	67 (2)	50 (1)	50 (1)	...	..	
54 (7)	46 (6)	36 (5)	64 (9)	36 (4)	64 (7)	100 (2)	...	100 (1)	...	
40 (6)	60 (9)	80 (4)	20 (1)	50 (2)	50 (2)	...	100 (1)	...	...	* Three of these stumps omitted from columns 5 to 10 on account of being burnt, so height unknown.
100 (5)		67 (2)	33 (1)	50 (1)	50 (1)	...	100 (1)	...	100 (1)	
57 (4)	43 (3)	50 (1)	50 (1)	25 (1)	75 (3)	...	..	...	...	
25 (2)	75 (6)	..	100 (2)	100 (2)	...	...	100 (1)	100 (2)	...	
50 (5)	50 (5)	...	100 (1)	...	...	...	...	...	.	
29 (2)	71 (5)	...	100 (1)	50 (1)	50 (1)	...	...	...	...	
46 (69)	54 (80)	45 (61)	55 (73)	47 (43)	53 (49)	39 (14)	61 (22)	50 (8)	50 (8)	

SCHE

Percentage of live and dead stumps with

1	2		3		4	
Year of felling	TOTAL		CIRCUMFERENCE 2′ OR LESS.		CIRCUMFERENCE 2′ TO 4′.	
	Live.	Dead.	Live.	Dead.	Live.	Dead.
1894-95	73 (51)	27 (19)	47 (7)	53 (8)	82 (36)	18 (8)
1895-96	50 (25)	50 (25)	60 (3)	40 (2)	38 (13)	62 (21)
1896-97	36 (29)	64 (51)	20 (4)	80 (16)	43 (22)	57 (29)
1897-98	48 (24)	52 (26)	37 (3)	63 (5)	36 (8	64 (14)
1898-99	31 (21)	69 (47)	...	100 (5)	35 (15)	65 (28)
1899-1900	68 (65)	32 (30)	58 (26)	42 (19)	79 (38)	21 (10)
1900-01	44 (44)	56 (56)	54 (19)	46 (16)	42 (24)	58 (33)
1901-02	51 (26)	49 (25)	33 (1)	67 (2)	47 (15)	53 (17)
1902-03	38 (21)	62 (34)	...	100 (1)	39 (16)	61 (25)
1903-04	52 (26)	48 (24)	67 (8)	43 (6)	51 (18)	49 (17)
1904-05	43 (22)	57 (29)	59 (10)	41 (7)	33 (10)	67 (20)
1905-06	31 (16)	69 (35)	50 (1)	50 (1)	37 (13)	63 (22)
1906-07	42 (22)	58 (31)	55 (6)	45 (5)	42 (16)	58 (22)
1907-08	38 (20)	62 (33)	67 (2)	33 (1)	46 (11)	54 (13)
For the fourteen coupes as a whole.	47 (412)	53 (465)	49 (90)	51 (94)	47 (255)	53 (279)

DULE B.

reference to size of stump felled.

5		6		7
CIRCUMFERENCE 4′ TO 6′		CIRCUMFERENCE ABOVE 6′.		REMARKS.
Live.	Dead.	Live.	Dead.	
75 (6)	25 (2)	67 (2)	33 (1)	In columns 2 to 6 the figures in brackets denote the number of stumps measured and the figures not in brackets denote the percentage.
88 (7)	12 (1)	67 (2)	33 (1)	
28 (2)	72 (5)	50 (1)	50 (1)	
75 (9)	25 (3)	50 (4)	50 (4)	
33 (6)	67 (2)	...	100 (2)	
50 (1)	50 (1)	...	...	
17 (1)	83 (5)	...	100 (1)	
62 (8)	38 (5)	67 (2)	33 (1)	
38 (5)	62 (8)	.	...	
..	100 (1)	...		
50 (2)	50 (2)	...	...	
15 (2)	85 (11)	...	100 (1)	
...	100 (4)	...	...	
26 (6)	74 (17)	33 (1)	67 (2)	
41 (55)	59 (77)	45 (12)	55 (15)	

SCHEDULE C.

No. of shoots per stump and growth in girth and height

Year of felling.	Years after felling.	No. of shoots per live stump.	Average circumference of largest shoot at breast height in inches.	Average height of largest shoot in feet.	REMARKS
1894-95	14	3·4	11·0	13·9	
1895-96	13	2·2	9·8	14·5	
1896-97	12	3·4	6·9	11·7	
1897-98	11	3·2	11	17·0	
1898-99	10	2·8	8·8	15	
1899-1900	9	2·5	8	13·6	
1900-01	8	3·3	4·3	9·6	
1901-02	7	2·7	6·3	11·1	
1902-03	6	3·5	6·8	12·5	
1903-04	5	2·6	6·0	11·7	
1904-05	4	2·9	2·7	6·7	
1905-06	3	2·6	2·0	6·0	
1906-07	2	3·0	...	1·6	
1907-08	1	2·8	...	1·4	
	For the 14 coupes as a whole.	2·9	...	...	

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

THE SPORTSMAN IN BURMA.

(*Continued.*)

IV. THE CARNIVORA.

The true carnivora in Burma are represented by the tiger, leopard, and various species of wild cat, some with very beautiful skins. Bears, though not exclusively carnivorous, may be added to the list. Tigers are fairly plentiful throughout the country, from the confines of Manipur and Assam to the Malay States of the Peninsula. The finest specimens are found in the deep forests of the higher ranges, and in the Hupong Valley of the extreme north. Sportsmen generally classify tigers under three headings: (1) Forest tigers, which frequent the deepest forests, and live entirely on deer, pig, and other wild animals; (2) cattle-eating tigers, which frequent the outlying fringes of jungle in proximity to cultivation, and which prey upon domestic cattle grazing in the jungle fringe or browsing on leaves and shoots when the grazing grounds are scorched and burnt up and fodder is scarce; and (3) man-eaters, which are invariably found in the neighbourhood of outlying villages bordering on the jungles. The killing of these pests is one of the most beneficent acts of the sportsman.

It is easy to understand how the forest tiger may become in course of time a cattle-eater, and later on a man-eater. When, owing perhaps to age or laziness, a tiger finds it difficult to chase and catch deer or wild pig and, in the course of his wanderings, comes upon domestic cattle, which he finds an easy prey, he will at once make his lair in the cattle-feeding area and abandon the deep forests which he formerly frequented. The transition from cattle-slaying to man-slaying is not a great step. Jungle-feeding cattle generally carry large bells of bamboo clappers round their necks, the noise from which tends to scare the tiger from the herd. Where, however, cattle abound human beings will be met with

and men and women are continually making expeditions into the jungles to cut bamboos, gather fruit, or collect firewood, and one day the cry will be raised, "Kya-kaik thè" (killed by tiger), and some wretched villager will have been carried off. Once the tiger has tasted human blood he prefers it to that of cattle, and so day after day he claims a victim, and will even enter the village or hamlet and carry off sleeping persons from the verandahs of their huts. Although tigers as a rule have their regular beats or hunting grounds, they sometimes wander far from home. A well-known man-eater in Central India was known some years ago to have devastated an area of nearly 250 square miles, but was eventually killed.

About thirty years ago a tiger swam the Rangoon River—nearly a mile in width—and landed on the Strand Road in the heart of the business quarter. It subsequently crept under the raised floor of a Burmese hut, where it was shot by Mr. G. G. Collins, at that time an inspector of police Where it came from no one knew, for tigers are seldom seen in the Deltaic region. About six years ago, a large tiger was observed on the platform of the Shwe-Dagon pagoda at Rangoon, and was shot by a party of soldiers told off for the purpose. The superstitious Burmese attributed the outbreak of plague in Rangoon to the shooting of this tiger, which they declared was some particular manifestation of the Buddha. It is a curious fact, however, that the plague outbreak occurred shortly afterwards, and the city has not since been free of the scourge.

Forest tigers are seldom seen by the sportsman, but their pugs are frequently met with when following up bison and tsine. Like the lion, they hunt at night and spend the day in sleep, their lair being generally in proximity to water. Cattle-killers and man-eaters, as already stated, are found near villages, and it is amongst these that the sportsman will take his pick. Owing to the immense amount of damage done to cattle, and loss of life to villagers, no time is lost by the latter in reporting to headquarters the ravages of a tiger, and the local forest officer or superintendent of police, generally rids the neighbourhood of the pest.

The usual mode of shooting tigers is to sit up over a kill, and fire from a *machan* built in the forks of a tree at some distance from the ground. Such shooting is only possible on moonlight nights, and even then the difficulties are varied and numerous. The glorious beats for tiger mentioned by Colonel Pollok in his interesting book on sport in Burma forty years ago are, alas! things of the past, and few, if any, elephants are now trained for such purposes. In all districts fringing the hills, however, tigers are numerous, and the sportsman may be sure of bagging them if he is prepared to spend a little money on purchasing and tying up cattle and sitting up over the kill.

The leopard is plentiful, especially in Upper Burma and the Shan States. When seen by man it generally slinks away from him, and is seldom observed in the open forest. It frequents the low jungles and hills near villages and carries off dogs and poultry at night. Sometimes it is very bold in its depredation. A friend of mine, walking home from the club along a well-lighted street in Katha, in Upper Burma, one evening, had his fox-terrier taken from behind him by a leopard, and on one occasion when I was coming into Thabeikyin, from the Ruby mines late at night a leopard sprang at and missed a large white dog of mine, disappearing into the jungle on the other side of the road. On the Monywa Myin-mu Road one night, I almost fell over a leopard lying asleep in the dusty cart-rut. He bounded off, however, snarling, and I saw no more of him. When wounded, the leopard is infinitely more dangerous than the tiger, and I could mention the names of four or five men I have known who lost their lives by following up a wounded leopard. Sometimes cattle-killing leopards are mistaken for tigers, and it is not till they are accounted for by the sportsman that the mistake is discovered. From this it will be gathered that leopards are common throughout the Province, and that no particular locality is especially favoured by them, so that the sportsman should always be prepared to meet them.

Of the smaller Felidæ there is little to be said. The tiger-cat is very beautifully marked, as is the ordinary jungle cat, but, though frequently seen when tracking big game, they are generally

let alone, lest the report of firearms should alarm the larger quarry of which the hunter is in search.

Two species of bear are found in Burma, their distribution being general throughout the Province. The Himalayan bear (*Ursus torquatus*) is found principally in North Burma and Assam. It is a vegetable eater, but sometimes takes to stealing goats. The Malayan bear (*Ursus malayanus*) is much smaller. It is generally frugivorous, but varies its diet with birds and small mammals; it walks very rapidly, and climbs with great agility. Both species frequent the forests, and are seldom seen near habitations.

V. DEER, WILD DOGS, ETC.

The Cervidæ are well represented in Burma by the sambur, thamin (or brow-antlered deer), hog deer, barking deer (or muntjac), and the graceful but diminutive mouse deer. The sambur (*Cervus aristotelis*) is generally diffused throughout the province, and is the largest of all true deer found in the East. The true hill sambur are far finer animals than those which frequent the plains. A full grown sambur exceeds 5 ft. in height, weighing from 40st. to 50st., and is covered with deep brown coarse hair. The antlers are usually symmetrical, but are not so fine as those of the Bara-singha, or marsh deer of the Indian peninsula. Tame sambur are often seen in jungle towns, where they wander about the streets, and are fed by the charitable Burmese residents. A friend of mine had a pair which he trained to run in double harness and draw a light cart. Sambur stalking in the deep forests of the higher ranges is a most fascinating sport, but in the plains it is only possible to get them by beating patches of elephant grass, often 20 ft. in height, in which the sambur rests during the heat of the day or when his horns are in velvet Sometimes the villagers fire the tall grass, but this is unadvisable, as the terrified occupants are frequently devoured by the flames rather than fall victims to the sportsman's gun.

The thamin, or brow-antlered deer (*Cervus frontalis*), is very handsome, and was formerly plentiful in Manipur, the Chindwin

valley, and the Thaton plains, but, owing to its ruthless destruction by the Burmese hunters, its numbers have been much diminished. The name "brow antler" is given from the fact that the brow tine curves down over the forehead, forming a continuous sweep with the beam, the latter being curved. This deer is essentially a frequenter of the plains, where it feeds principally on wild rice, and is also fond of browsing on aquatic plants found growing in rain-water jheels. It is gregarious in its habits, as many as forty or fifty being sometimes found in a herd. In the Lower Chindwin district thamin are still fairly plentiful, and the usual way of stalking them throughout Upper Burma is for the gun to seat himself in a bullock cart. To the bullocks bells are attached, and the cart is driven here and there through the plain. The thamin are attracted by the bell tinkling, and stand staring at the approaching cart, and the hunter selects his quarry and lets drive. If stalking on foot is resorted to, the sportsman can seldom get closer than 300 to 400 yards, and a bullet from a rifle at that distance, unless planted in a vital spot, seldom kills.

In the Burmese times, annual battues were held during the height of the rains for the ruthless slaughter of this handsome beast. As the flood waters rose in the vast Thaton plains the herds congregated on the higher ground, and gradually converged more and more on what subsequently became small islands surrounded by the surging flood waters. In rushed a crowd of shrieking Burmans, armed with dahs and spears and matchlocks, and the whole herd was wiped out. Needless to say, thamin are seldom seen now in these plains, where they were once so numerous.

Hog deer (*Cervus porcinus*) are found in all parts of Burma. I have shot many in the mangrove swamps fringing the banks of tidal estuaries, and small patches of elephant grass dotted about the cultivated plains simply swarm with them. This deer is so called from its hog-like manner of hanging its head when running. It averages about 2 ft. at the withers, but has very short legs and a long body in proportion. Hog deer are not gregarious, and it is seldom that more than three or four are seen together. They require some hitting, and I have generally shot them with slugs

from an ordinary shot gun. I remember once shooting one with a M.-H. carbine, the bullet smashing the thigh; but the deer got away, and was only discovered by chance shortly afterwards, having gone over 400 yards on three legs.

The barking deer, or muntjac (*C muntjac*), is so called from the extraordinary dog like bark it utters when frightened or disturbed, and is very common throughout Upper and Lower Burma. It is a solitary animal, frequenting the forests and patches of jungle between cultivated fields, emerging from the forest to the fields morning and evening to graze. The flesh is sweet and tender, and is a godsend to the district official, who has to live more or less on chicken, or "sudden death" as it is called in the East.

The mouse deer (*Memimna indica*), an elegant, diminutive specimen of the deer tribe, is very common in the Tenasserim Province, but is seldom shot. It is about the size of a hare, and frequents the open forests. Native hunters secure it by placing low nets between the bushes, into which these deer are driven. So cute are these deer that on being taken from the net they will frequently feign death, and in this way ultimately escape. They do not live for long in captivity, owing to the inability of the owner to procure natural food, but they thrive for a time on bananas.

This series of articles may be concluded by a slight reference to certain types which have not been previously dealt with. Of such are the wild hog, the serow or wild goat, and the wild dog. Wild hog (*Sus indicus*) are very common both in the delta and in the upper province, and their depredations are a serious source of annoyance to gardeners, fruit and vegetable growers, and to the ordinary cultivator. Villagers will gladly turn out to beat the jungles for the guns, provided that they share in the spoils of the chase The wild boar is ferocious and plucky, so it is advisable for the sportsman to take up his position on a previously erected platform, or to secure himself across the branches of a favourable tree, where he can use his gun but be out of the way of this brute's formidable tusks. Owing to the want of favourable ground, that grand sport pig sticking is not practised in Burma. Serow, or wild goat (*Nemorhaedus rubidus*), is found among the limestone

hills scattered about the Salween Valley, particularly at the Duke of York's Nose. It is very dark red brown in colour, about 5 ft. in length, and weighs about 200lb., and very seldom seen unless searched for. Native hunters speak of a much larger species as existing in the mountains, but no authentic details of its existence are available. The wild dog is about the size of an ordinary pariah, has a very bushy tail, and hunts in packs of as many as fifty in number. I have seen them in the Taung-waing Hills, near Moulmein, where they worry and destroy domestic cattle. I have also shot them in the Shwebo district of Upper Burma.

In the introductory article of this series, mention was made of the wildfowl shooting obtainable in Burma, and as the season when wildfowl are plentiful synchronises with the period selected for big game shooting, it will be possible for the sportsman to vary forest tracking with duck shooting on the many jheels which are to be found in all parts of Burma. I am indebted to Mr. A. J. A. Jardine, the greatest authority on duck and teal in Burma and one of Burma's best sportsman, for the following list of duck and teal shot by him at various times in all parts of the province: Comb duck, or nukta; ruddy sheldrake, or Brahminy duck, grey duck, pintail, shoveller, common teal, garganey or grey-winged teal; cotton teal, whistling teal, large whistling teal. All these species are common throughout both the Upper and Lower Provinces, while the gadwall, wigeon, red-headed pochard, crested pochard, common sheldrake, or burrow duck, and mallard have only been shot in Upper Burma. Mr. Jardine also shot at Haingyi, near Cape Negrais, a specimen of the oceanic teal, which was probably driven landwards from the Andamans by a storm.—(*By George W. Bird, in the Field.*)

UNMATED BIRDS.

One of the most curious phenomena in the economy of the fowls of the air, is the large number of sexually mature birds that appear to be unable to find mates at the breeding season. Popular books on natural history convey the impression that at

the nesting season all birds mate. This, like many other ideas set forth in popular ornithological works, is probably an erroneous one. Even as among human beings the hero and the heroine do not always marry one another, so is it probable that every little bird does not succeed in securing a mate.

Charles Darwin touched upon this subject, but, as is so often the case, those that have come after him have failed to follow up his investigations. Darwin informs us, in *The Descent of Man*, that Lord Lubbock's game-keeper has repeatedly shot one of a pair of jays and has never failed shortly afterwards to find the survivor rematched. The same phenomenon has been observed in several cases where one of a pair of carrion crows, peregrine falcons, kestrels, golden eagles, or owls has been caught or shot.

"I could," writes Darwin, "add analogous cases relating to the chaffinch nightingale and redstart. With respect to the last bird (*Phœnicura ruticilla*) a writer expresses much surprise how the sitting female could so soon have given effectual notice that she was a widow, for the species was not common in the neighbourhood. Mr. Jenner Weir has mentioned to me a nearly similar case at Blackheath; he never sees or hears the note of the bullfinch, yet when one of his caged males has died, a wild one in the course of a few days has generally come and perched near the widowed female, whose call note is not loud . . . . One of a pair of starlings was shot in the morning, by noon a new mate was found; this was again shot but before night the pair was complete; so that the disconsolate widow or widower was thrice consoled during the same day."

Darwin further states that Mr. Engleheart shot in one season thirty-five starlings from the same nest; these consisted of both males and females, but in what proportion he could not say: nevertheless, after all this destruction a brood was reared.

In *Bombay Ducks*, I have recorded a case where a man, in order to deter a pair of sparrows from nesting in his verandah, slew the cock. The hen replied to this by returning in a few minutes with a second husband. He shared the fate of number one. Nothing daunted, the hen returned with number three. He too, was gathered unto his fathers shortly after his arrival, but was

soon replaced. And this process continued until that hen sparrow had lured six cocks to their doom. At that stage the man in question stayed his hand. Gilbert White of Selborne had a similar experience. His grievance against a pair of sparrows was that they deprived the house-martins of their nests. He, therefore, shot one of them, but the one that was left " be it cock or hen, presently secured a mate, and so for several times following."

Mr. G A. Pinto, in Lahore, accidentally killed a hen yellow-throated sparrow (*Gymnorhis flavicollis*) which was incubating. He observed that there was another hen at the nest on the following day.

It is thus evident that in the case of, at any rate, many species of birds when one of a mated pair is killed, the other, instead of moping and pining, as the poets assures us it does, forthwith proceeds to secure another mate.

These cruel experiments are of considerable interest. They show, in the first place, how greatly birds are dominated by instinct at the nesting season.

As I have said elsewhere, birds when they have eggs or young ones seem to throw intelligence to the winds, and to become mere automata. I maintain that no bird that exercised its intelligence would remain on at its nest after a couple of its successive mates had been shot.

This, however, is but a side question. The main issue is what are all these unpaired birds of both sexes about? How is it that they have not mated among themselves? It cannot be that they are not sexually mature, or are averse to marriage, for if this were so they would not come forward so readily to take the place of the bird that has been slain or captured.

Darwin suggests that these second husbands or wives may be those whose mates have been killed or have succumbed to illness. He further is of opinion that "birds which have had their nests destroyed, or barren pairs, or retarded individuals, would easily be induced to desert their mates, and would probably be glad to take what share they could of the pleasures or duties of rearing offspring although not their own."

Each of these suggestions would explain the existence of a certain number of eligible partners for bereaved spouses.

We must also bear in mind, that all the individuals of a species do not, as a rule, become simultaneously ready for breeding, so that it is possible that the bereaved cock or hen, as the case may be, is able early in the season to secure as a second spouse an individual which would ordinarily have bred later; similarly, towards the end of the breeding season it is likely that a bird that has already brought up a family that year would be willing to enter into a second alliance.

Another suggestion which, if true, would explain the existence of a number of unmated birds is that the fowls of the air, like human beings, are not willing to mate with the first individual of the opposite sex they see, that they refuse to pair until they meet with another bird pleasing to them. Against this suggestion, is the apparent facility with which a new mate is found. If in such cases there be any courtship it must be exceedingly brief. Of course, it is possible that the bereaved bird has some means of communicating to other birds that it has a nest and eggs or young and is in urgent necessity of a helpmate. In this connection it is of interest to note that in certain cases where the cock has been repeatedly shot, the hen has eventually brought in, as her mate, a cock in immature plumage. This would seem to show that she was unable to procure a fully adult bird and so had to be content with one that was either not ready for breeding, or was, on account of his immature plumage, not able to attract a hen although quite ready to pair. This brings us to the question of sexual selection.

The somewhat scanty evidence available points to the fact that birds and beasts, so far as is possible, pick and choose their mates, and that it is not so much beauty, as sexual vigour which is attractive to the opposite sex. As Mr. Tegetmeier has pointed out, hen bantams appear to mate as readily with cocks that have been dubbed and deprived of all their ornaments, as with those in the full glory of their masculine splendour. It is quite possible that birds, as regards their suitors, have far stronger likes and dislikes than we suspect. If this be so, it is probable some mature

birds do not mate for reasons similar to those that cause some human beings to remain bachelors and old maids.

The point that requires determination is whether or not there are sexually mature birds that do not pair, even though sexually mature individuals of the opposite sex are available.

I believe that most ornithologists would, without hesitation, answer this question in the negative. Nevertheless, I am rather inclined to think that this would be not the correct answer, but one dictated by preconceived notions of the economy of birds. The matter can be settled only by actual observation. The observation will be very difficult to carry out among birds in a state of nature. In the aviary it frequently happens that certain mature individuals do not mate, but this may, of course, be due to the somewhat unnatural conditions in which the birds are kept.

We must bear in mind that in polygamous species many of the adult cocks are obviously unable to find mates. In such cases the unpaired cocks seem to thrive well enough.

If any one happens to have recorded any observations on this most interesting subject, I trust that he will be good enough to communicate them to me.

D. DEWAR.

"THE TIME OF THE SINGING BIRDS IS COME."

We have it on indisputable documentary evidence that Solomon, the Wise King of Israel, was the first botanist, zoologist, ornithologist and entomologist; for is it not said of him that "he spake of trees, from the cedar in Lebanon even unto the hyssop that springeth out of the wall: he spake also of beasts, and of fowl, and of creeping things, and of fishes?" But though sacred history tells us so much, it gives us no information of the fowls of that distant time, so it is hopelessly impossible to associate the singing birds of Solomon's time with the sweet warbles of our day.

"The time of the singing birds" synchronises with the florescence of the vegetable kingdom; in fact it is a natural consequence

of it. Solomon recognised this; therefore he wrote: "The flowers appear on the earth; the time of the singing birds is come, and the voice of the turtle is heard in our land." By the appearance of the flower and the new foliage, the whole landscape is changed and beautified; the air is rendered odorous; Nature is at her best, and smiles her incitations to every creature. There is a promise in every flower. What more natural, then, than that the birds should be attracted by this glorious welcome, and flock in to partake the good gifts offered them? Unlike those thankless persons we read of in Scripture, who "straightway began to make excuses" for not attending a feast to which they had been invited, the birds make none. No; they respond to the call in a hearty manner, and they return grateful thanks in sweet song. But to appreciate the sweet symphony, one must go far into the country; for the singing birds are not partial to cities and large towns. A large expanse of tree growth is a *sine quâ non* for bird life. A few months ago, when I was engaged in perambulating the Mysore-South Canara frontier line, I halted to have breakfast one afternoon by the side of a stream which flowed through dense evergreen jungle. I had done a good hard climb, and felt fagged out. So, while my servant was preparing my modest meal, I stretched myself out on the fallen leaves, and lit a cigar to beguile the time. That jungle simply swarmed with birds, and they treated me to such exquisite melody that it was with a sigh I left them, when the time came to march on.

The time of the singing birds begins with January, and it is at its best in April and May. At this time of the year the trees are in full bloom, and their foliage looks clean and tidy after the "chota barsath." The air is redolent of the sweet odour of the Sampege (*Michelia Champaca*), Coffee, Albizzias, and other forest trees.

The quiet of November and December is suddenly broken by the arrival of the Cholum birds (*Pastor roseus*), which flock in hundreds. They remain with us for a couple of months and then take their departure. During their stay, the air resounds with their merry twittering. They are found more plentifully in the vicinity of villages than in the heavy jungle remote. But whether

in the neighbourhood of human habitations or in the Ghats, they affect the society of the Myna more than any other bird. *Pastor roseus* is not a timid bird; but the moment the Myna gives his warning of the approach of an enemy and takes to flight, the whole flock follows suit. Sometimes the birds follow the Myna, at other times they go for a mad turn in the air, and descend with a swoop on to a tree far away. In the Ghats, the Cholum bird and the large hill Myna play sad havoc with the flowers of the Boorga tree (*Bombax malabaricum*). The hill Myna (*Eulabes religiosa*) is rather larger than any of its cousins. It is quite black; but it has a yellow beak, yellow legs and yellow wattles. The bird (I presume it must be the female) never tires of calling for the "Ayah" in a highly affected tone.

Another very black bird which is found in the ghats is the Drongo cuckoo (*Surniculus lugubris*). It is uncommonly like the king crow (*Dicrurus ater*), but is a larger bird. In its forked tail are too long feathers which are, or seem to be, bared of barbs enough at the tips; and as the bird shoots into the air and returns to its perch in the form of an ellipse, it cuts a very fantastic figure. This bird (I suppose that in this case too it must be the lady) appears to be incapable of saying anything more than "Stop yer ticklin, Jock!"

Close on the heels of the Cholum bird come the beautiful Orioles (*Oriolus kundoo* and *melanocephalus*). Both kinds visit these parts; and when the bird was with us a short while ago, a pair of the black-headed kind used daily to visit a jack tree right in front of my door. The pair has since departed. The Oriole is not a song-bird; but there are few that can compete with him in point of colour. He is a blaze of gold, and commands one's attention. Another bird which one cannot escape seeing is the little rosy minivet (*Pericrocotus roseus*). He is a Morman by instinct; and as he flits from tree to tree with his wives, the contrast between his bright apparel and the sombre frocks of his ladies is very marked.

The Barbet (*Thereiceryx zeylonicus*) is very plentiful, especially in the Ghats; and one gets tired of his never-ending "kutur, kutur

kutur." The "Idle school-boy" is another bird very plentiful in the Ghats; but being of a very retiring disposition, it is no easy matter to find him. I cannot say for a certainty that I have seen the bird; but if he is reddish in colour, and has a fairly long tail which is cut quite square at the end, I have seen him. The Canareese name for the bird is said to be "Bagani karan hakki." Now "bagani" is the toddy obtained from *Caryota urens;* "karan" means a dealer, and "hakki" means bird. So the vernacular name might be translated as "the bird of the bagani toddy dealer." It would be useless to ask the ryot why the bird is so called, because he will either tell you that he does not know, or else he will lay the blame on some ancient long gathered unto his fathers. Perhaps the bird owes its vernacular name to its maudlin way of whistling, and yet it is far from being unpleasant. On one occasion I was walking through a bit of dense jungle with a Brahmin Forester when an Idle school-boy" commenced whistling; and whether it was to show us what a clever fellow he was, or whether it was owing to some domestic felicity, that bird made that jungle ring again. I made certain that the Forester would pass some remark about the bird; and since I wanted it to come spontaneously, I refrained from in any way drawing his attention to the bird. I had not long to wait, for as soon as the man's risible faculty was touched, he remarked with a laugh—"how merrily that bird is whistling!"

The cherry sultan bulbul (*Otocompsa fuscicaudata*) is very plentiful in these parts, much more so than the ordinary black one (*Molpastes hæmorrhous*). A pair has built their nest in the roof of my bullock-shed, and the male bird spends much of the day in singing praises to his wife. That is his way of keeping her from galavanting.

The Yellow Hammer, Fantail Flycatcher (*Rhipidura albi-frontata*) and White-eye (*Zosterops palpebrosa*) all have sweet little songs of their own; but our chief songster at present is the Dyer bird. The Dyer begins his matins at 5 o'clock in the morning, and performs them in snatches. Like the Styrian milkmaids these birds have a knack of singing at each other, or carrying on a running conversation in song; and since no two of them appear

to know the same strain, the net result is very agreeable. The Dyer is a song-bird, par excellence, and no one seems to be better aware of that fact than the bird himself. Unlike the "Idle schoolboy," who does his whistling in concealment (for very good reasons), the Dyer loves to make himself conspicuous when he is engaged in song. The bird never seems to tire of singing; and he always throws all his soul into his song. He is the first to greet the new-born day, and the last to say "goodbye" to it.

I cannot conclude this article without expressing my indebtedness to "D. D." for the scientific names of the birds I have mentioned

D. J. EVERS,
Forest Range Officer, Manzarabad Range,
Sakluspur P. O., Hassan Division, Mysore State.

EXTRACTS FROM OFFICIAL PAPERS.

DECENTRALIZATION OF THE TRAINING OF FOREST RANGERS.

Circular No. $\frac{9}{259\text{-}2}$ *F., dated* 1*st March* 1909, *from the Secretary to the Government of India, to all Governments and Administrations.*

I AM directed to address you on the subject of the future training of Forest Rangers, which arises incidentally out of the proposals formulated by the Committee appointed in March last by the Secretary of State to enquire into the recruitment and training of probationers for the Indian Forest service. In this Department's circular No. 7 F.—185-6, dated 25th January 1909, you have been asked to give an opinion on the latter subject.

2 On the raising of the status of the Forest School at Dehra Dun to that of an Imperial Forest Research Institute and College, it was decided to abandon the vernacular class at that institution and in Mr. Wilson's circular No. 31 F.—166-4, dated 9th October 1906, Local Governments were invited to make arrangements for

the training of their lower subordinates. A ready response was made to this suggestion, and forest schools for the training of deputy rangers, foresters and guards have now been established in all the larger provinces.

3. It was at that time the intention of the Government of India that the Dehra Dun College should continue to meet the demand for the trained rangers, that the staff of experts should give lectures, each in his own subject, and that the practical work in the forest should be conducted by officers of the Provincial Forest service, who are attached to the College specially for purposes of instruction. In order to meet the increasing demand for admissions to the College, the total number of students undergoing the course of training was in 1906 raised to 120, which would ordinarily admit of 60 new admissions yearly, but even this measure has proved inadequate, for during the past year applications for admission to the College were received from 110 candidates. Experience now shows that classes of 60 men are too large to handle properly, and it would obviously only intensify existing disadvantages if any attempt were made still further to enlarge the classes.

4. In addition to the schools which have been organised for lower subordinates in the various provinces, special local requirements in Burma have been met by the provision of training for rangers in connection with the school for the education of lower subordinates. The Madras Government have also recently put forward a proposal to establish a Forest College at Coimbatore to train annually 30 rangers for that Presidency and the adjacent Native States. These measures will in time afford some relief to the College at Dehra Dun, but the Government of India believe that the demand for the education of rangers must continue largely to increase. In nearly all provinces there have recently been considerable additions to cadres, while Native States and the Colonies make annually increasing demands.

3. Until quite recently Dehra Dun had many advantages over any other place in India, as a centre of education for Rangers, and the Government of India considered that it was convenient to have

the comparatively small number of men required, trained at one centre. With the development in scientific forestry which has everywhere taken place of recent years, there should now be much less difficulty than formerly in selecting centres throughout India where forest rangers can be properly educated, and at the stage now reached there appears to be no reason why the Government of India should continue to arrange for the training of forest subordinates any more than they do the training of revenue and police subordinates. The progress made in the various provinces in the education of lower subordinates, and the steps taken in Burma suggest that the scope of some of the existing schools could be extended so as to provide a class for rangers in the larger provinces. Before, however, asking Local Governments to consider any definite proposals as to future arrangements the Government of India would like to have some information as to the requirements of different provinces, and I am therefore to ask that..............the Government of India may be furnished with an approximate forecast of the annual number of rangers likely to require training ....during the next ten years.

AMENDED RULE REGARDING THE GRANT OF HONORARIA FOR THE PREPARATION OF WORKING PLANS.

The following amended rule sanctioned in Government of India Circular No. $\frac{10}{260-13}$ F, dated the 8th March 1909, came into force from that date and will be embodied in the Forest Department Code [Article 21 (ii)].

RULE.

"The Local Government may, when a working-plan has been approved and accepted, sanction to any officer who may have been in charge of such plan, a remuneration which shall not exceed Rs. 100 per mensem for the time during which he has been at work on such plan. In the case of a specially appointed working-plans officer, no remuneration shall be granted unless the Local Government is satisfied that the officer has undergone exceptional

exposure or incurred exceptional expenditure. In the case of a Divisional Officer entrusted with the compilation of a working-plan in addition to his ordinary duties, the Local Government, if satisfied that the plan has entailed very considerable extra labour, may sanction a similarly limited remuneration. The amount of the allowance and the period for which it is granted will be decided, on the merits of each case, by the Local Government concerned. * * * *"

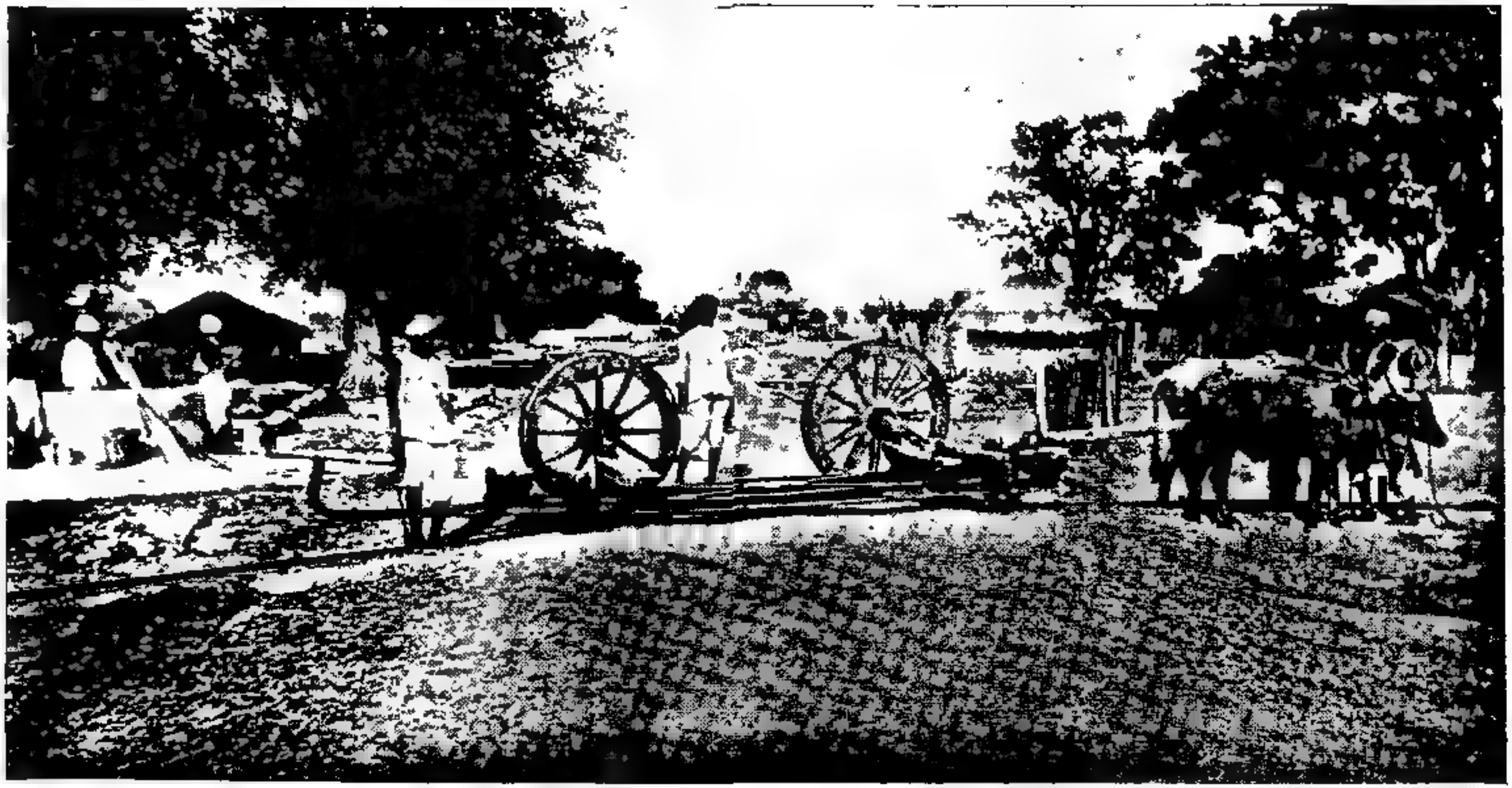


Photo-Mech. Dept. Thomason College, Roorkee. Photo by J. C. Pringle R. E.

A Monorail Truck for Logs, Allapilli, Chanda, C. P.

VOLUME XXXV

NUMBER 8

INDIAN FORESTER

AUGUST, 1909.

AFFORESTATION AND TIMBER-PLANTING IN GREAT BRITAIN AND IRELAND.*

The CHAIRMAN, (The Right Hon. Sir Charles Wentworth Dilke) in introducing the reader of the paper, said he was present to be shot at, because in the discussion which was supposed to have taken place upon the topic in the House of Commons, he was reported as having said that the recent scheme laid before Parliament was finance of a wild-cat order. He did not, however, make that statement in a debate on forestry, but on unemployment, Mr Guest, the Chairman of the Royal Commission, having brought the subject of forestry forward as a remedy for casual unemployment. On that occasion he said he feared that the calculations that "were laid before them, so far as England was concerned, could not be accepted as financially sound." He carefully excluded Scotland, Ireland, and Wales from what he said, because the evidence with regard to Scotland was very strong. Ireland had always been treated separately, and the Commission made a case, though he felt it was rather a doubtful one, with regard to Wales. As for the very large scheme laid before the House, which the paper described as outside the terms of reference to the commission on Coast Erosion, he feared that the cause of afforestation might be found to have been damaged by the rather loose finance with which it had been there associated so far as concerned the chance of a great coniferous afforestation scheme in England being a paying concern. There had been four enquiries recently made into the matter. The latest of all, in 1908, on which the cause of afforestation was represented by Mr Rider Haggard and Prof. Somerville, reported on afforestation as a means of increasing employment during periods of depression in the

* Read before the Royal Society of Arts on 24th March 1909.

labour market. On April 28th, a new warrant was issued, adding the question of afforestation to the reference of the of the Royal Commission on Coast Erosion, originally limited to the sands of the sea-shores or districts reclaimed from the sea, and dealing only with the unemployed. The first of the new series of witnesses was then called before the Commission, and then there dawned upon them a gigantic scheme, supported, financially speaking, as far as England was concerned, by evidence which was at least inconclusive. The Commissioners were directed to form a scheme for an experimental treatment of forestry in connection with unemployment, and they brought forward a coniferous scheme dealing with millions. *His own belief was on the side of afforestation*, but he confessed it had been somewhat shaken by the evidence of the Commission. The practical point now before the country which had to be considered was how far it could be shown that the planting of coniferous timber in England would pay the State. That the experiment of growing Douglas fir in Scotland was a promising one he made no doubt, but it had yet to be proved that it would pay the Crown to plant Scotch fir, spruce and larch in England, and he had formed an unfavourable opinion on that point from the recent Report of the Commission. With regard to the duty of the Crown to plant and keep up oak forests, he thought a strong *prima facie* case had been made out in favour of a national scheme of afforestation, because in all changes of science, oak was likely to be necessary for many purposes, and the price of oak, though it might vary, would on the whole keep up. Oak took an average period of 120 years to mature, and only the Crown could afford to stand out of its money for that period. The question was affected in England by shooting; and even if the owner did not cut down all the timber that would make money at a given moment, thinning would be conducted upon the very opposite principles from those on which scientific forestry was based. He knew of a multi-millionaire who bought a magnificent series of English woods, and who proceeded to cut out of them the very trees which the woods were constructed to maintain, because the leaves of oaks of a particular size got in the way of the pheasants which he wanted to shoot. The *prima facie* case for maintaining oak forests was a strong one, but it meant good land upon which oak would grow in a period which would make it pay. A strong case had also been made out for ash, and probably other trees, and such things as osier growing; but the real question was as to the paying of coniferous timber under Crown management, with regard to which a very clear statement was needed before a new scheme was put before the country.

The following paper was then read by Dr. J. Nisbet:—

During the last twenty-five years, four Committees and Commissions have been appointed by Government to deal with the question of Forestry in the United Kingdom, and with what is now, by rather a lax use of the term, spoken of as Afforestation, when timber-planting is really meant. In 1887, a Select Committee of the House of Commons recommended the establishment of a Forest Board and Forest Schools in England, Scotland and Ireland, and pointed out that "apart from any immediate

pecuniary benefits, there would be considerable social and economical advantages in an extensive system of planting in many parts of the kingdom, especially on the west side of Ireland and in the Highlands of Scotland. This subject is one of great importance, and well worthy of early consideration." No action was taken in the specific directions recommended by this Committee.

The second inquiry was made in 1902, when a Departmental Committee of the Board of Agriculture was appointed "to inquire into and report as to the present position and future prospects of forestry, and the planting and management of woodlands in Great Britain." Reporting in 1903, they urged "immediate and effective provision for bringing systematised instruction within the reach of owners, agents, foresters, and woodmen . . . . as the first requisite in any project for the improvement of forestry," and recommended that "additional facilities for instruction be afforded,' and also that "assistance should be looked for from local authorities, societies and individuals interested in forestry and technical education." And they also made another very important recommendation, that Government "should take steps to compile a statement of areas presumably suitable for afforestation in Great Britain." But though they took note of "the great area of waste land in these islands which might be afforested," they expressly refrained from advocating "any general scheme of State forests under present circumstances," . . . . and merely remarked that "Once adequate provision for training is made and the consequent improvement of our present woodlands becomes manifest, it will then be opportune to raise the subject either of loans or of State forests." The drawbacks to private planting were dealt with as "Minor Considerations;" and while the Committee were not prepared to make any recommendation regarding the incidence of local rates on plantations and the assessed valuation of woodlands, they thought that the claims for "extraordinary traffic" made by local authorities against timber merchants (and therefore ultimately paid by the timber grower) were unjust and "unreasonable;" that the estate duties needed "immediate revision" as being "peculiarly unfair to the poorer districts," because "the pressure of such a death duty

on timber must both act as a bar to afforestation in districts most needing it, and compel the realisation of immature timber, thus preventing the practice of sound forestry;" that security was needed against fires from railway sparks (since very inadequately provided up to a maximum compensation of £100 under the Railway Fires Act, 1905); and that "in the public interest the owner of plantations, who himself keeps down ground-game, should have the right to recover compensation for damage caused by hares and rabbits from adjoining property," so ruinous are these to systematic forestry and natural regeneration.

Very little action was taken upon this report. Many of the most important recommendations have been tacitly ignored, and especially that recommending the detailed inspection and scheduling of land suitable for profitable planting, which must of course be a step taken before any practical scheme of very extensive planting can be properly considered. By not carrying out the recommendations of the Committees of 1887 and 1902, much valuable time has been lost.

The third inquiry was that which took place when, in October, 1907, a Committee was appointed by the Department of Agriculture in Ireland to advise regarding an extensive scheme of forestry operations. Previous to this, however, while the Land Purchase Act of 1904 was under consideration, certain preliminary inquiries had been made as to the extent of waste and poor land which might probably be plantable with a reasonable prospect of direct profit, and the late Mr. Parnell's estate (Avondale, co. Wicklow) had been acquired in 1903 and equipped as a school for the training of practical foresters. In April, 1908, this Committee's report was issued. It is by far the most business-like and practical afforestation and timber planting scheme that has as yet been suggested for any of the four countries forming the United Kingdom. It recommended the acquisition of sufficient land (including some of the existing 300,000 acres of woodland) to provide for the formation of about 700,000 acres of woods and plantations, of which about 200,000 acres or more should be State forests in large blocks, while about 500,000 acres of smaller areas should be under County

Councils or in private ownership. The weakest point in this scheme is, it seems to me, that it is not intended to confine planting operations to waste land and really poor grazing tracts worth only about a shilling an acre, but it recommends the afforestation of grazing land worth about 3s. 6d per acre on the average, and usually capable of improvement. Anyhow, what is of vast practical importance, it very plainly indicates how, in the Committee's opinion, the money for carrying out this Irish afforestation scheme should be obtained. These proposals are still under consideration, though nearly a year has gone by without any pronouncement having as yet been made on the subject by Government

The fourth and last inquiry was that instituted after the Association of Municipal Corporations had (in 1907) pressed upon the notice of Government "its opinion that the time has now arrived when the question of afforestation should be seriously considered," through the enlargement of the Royal Commission on Coast Erosion to report whether "it is desirable to make an experiment in afforestation as a means of increasing employment during periods of depression in the labour market, and, if so, by what authority, and under what conditions, such experiment should be conducted." Its report, submitted on January 4th, 1909, went far beyond the terms of reference as regards "an experiment in afforestation," and recommended the afforestation and planting of 9,000,000 acres, mostly grazing land at present, within the next 60 years, at a rate of 150,000 acres a year, and at a cost of £13 6s. 8d. per acre, £6 13s. 4d. being for the freehold and £6 13s. 4d. for the expenses of afforestation, or £2,000,000 annually though it also outlined a smaller scheme for afforesting and planting 75,000 acres annually at a total cost of £1,000,000 a year. With regard to the question of afforestation as providing suitable work for the unemployed, the Commission has reported that "They have no hesitation in asserting that there are, in the United Kingdom at any time, and especially in winter, thousands of men out of work for longer or shorter periods, who are quite ready and able to perform this or the higher class of labour." Here, however, their opinion is

diametrically opposed to that of the Irish Forestry Committee, who were unanimous in stating that afforestation would not prove a direct remedy for the chronic state of unemployment from which Ireland has for years been suffering, though they pointed out that any extensive scheme of planting must indirectly help to ameliorate the condition of the working-classes. The exact terms in which this clear Irish statement was made are as follows :—

"The question of promoting forestry as one of the means of dealing with what is called the problem of unemployment, having been brought to our notice, we think it right to state our opinion on this question. It is, emphatically, that forestry cannot be considered as a specific for curing the evil which is commonly understood when this problem is spoken of, that of the chronic disemployment, especially in large cities, of large numbers of people belonging to different trades or callings. That the promotion of forestry on an adequate scale will provide a great deal of employment is unquestionable, and that is one of its principal advantages to a country. But such employment would be employment naturally forthcoming from the plantations and woods for the agricultural population in their vicinity, and it would be employment for an industrial population, more or less rural, forthcoming from the industries and commerce which may be developed in connection with the conversion and handling of the forest produce. This sort of employment cannot be provided on a large scale at once. It must be developed with steadiness and system, and above all it must be on sound economic lines."

Our planting season is from autumn to spring ; and while the formation, tending, and harvesting of timber crops will increase the amount of employment given to the rural population, it seems hardly reasonable to expect that planting-work on wind-swept waste lands in autumn and spring can be suitable for the elderly, the weakly, and the least skilful and energetic, who must always be the first to be thrown out of work, and the last to become re-employed in our large industrial centres. But as a practical commentary on what the second city in the British Isles thinks of this remedy for the unemployed, it is noteworthy that on February

23rd, 1909, the Glasgow Distress Committee resolved that it should *not* be represented at any interview with the Secretary for Scotland—which deputation was received last Monday, March 22nd, two days ago—regarding a national scheme of afforestation.

On the average, a 60-year old wood should yield about 100 tons weight of timber per acre; and the felling, logging, transport, conversion and distribution of woodland produce will, of course, add directly and largely to the total amount of wages that would then be payable to labourers and workmen in this country, in place of being sent to foreign countries, as is at present the case. Indeed, there is hardly any branch of industry which would not benefit largely by our having extensive woodlands, and this obvious advantage is surely great enough to commend rational proposals for timber planting to our national business instincts.

The Royal Commission's vast scheme of afforestation is supported by financial calculations showing that timber-planting will prove a very profitable investment for the nation eighty years hence. These actuarial calculations have no practical value, for they deal with conditions and timber-crops which do not exist. They are little better than the usual prospectuses issued by vendors of concessions when floating speculative companies If such calculations, based upon vague data, always came true there would never be insolvent joint stock companies or bankrupt tradesmen, for reasonable business men only embark on ventures that give fair promise of being profitable; and the nation will be unwise to risk an investment of either one or two millions every year for the next sixty years, merely upon the hope of having very profitable money returns from eighty years hence onwards. It is indisputable that timber planting is desirable to the utmost extent possible, but a great national scheme of afforestation should rest upon a broader and surer economic basis than subtle calculations (based mainly upon German data as to yield) that may easily be partially upset by heavy gales like those which wrecked the Tay Bridge, at Christmas, 1879, blew down millions of trees in Perthshire, in November, 1893, and did a vast amount of damage to woodlands in Ireland, in February, 1903—to say nothing of

epidemic fungus diseases, such as the larch canker, to the development and spread of which our comparatively mild, humid and equable climate is even more favourable than it undoubtedly also is to the growth of timber trees. Unquestionably, extensive plantations would give work to the rural population, and would bring great and almost immediate advantage to agriculture, especially to stock raising, on wind-swept moors and hillsides ; and ultimately the handling of the timber-crops and the timber itself, as a raw material for many industries, would circulate a very large total amount of money throughout the British Isles. It is on these firmer economic realities, rather than on unreliable forecasts and calculations, that any national scheme of afforestation must be based ; and there can be little doubt that with the world's constantly increasing demand for wood, and constantly decreasing supply, well-formed plantations ought to prove a sound and remunerative investment if made prudently, and on a large scale.

The Commission has quoted many examples of profitable forestry in Britain ; but mention of dead failures seems to have been deliberately suppressed. What of the Knockby plantations in Connemara, where £10,000 were lost utterly on a site upon which the planting experiment was foredoomed to failure ?

It may be urged that these calculations as to profit eighty years hence are based upon German data ; but this presumes that German physical and economic conditions are analogous to our own, which is *not* the case. In Germany most of the vast woodland tracts have been under forest from time immemorial, have been under prudent management for generations, and have, for at least during the last sixty or seventy years, been worked with a scientific skill that we cannot hope to attain at once. Moreover, to plant bare, denuded, waste lands with timber is quite a different matter from merely improving the management of great natural forests. To create new woodlands on bare, impoverished, and often water-logged land involves a great capital outlay, with all the risk and disappointments attendant on a vast scheme of creating supplies of raw material for the establishment of new industries in the British Isles. And if German results be appealed to for guidance

in this particular business, then it is not to Saxony that one should look, but to Prussia, which has much greater resemblance to Britain so far as regards its northern climate, its partial seaboard and its great stretches of poor moor and heatherland, with a scanty population—although Prussia, too, has large areas of splendid spruce forests (Harz) and rich oak and beech (Solling, Ems, Weser, etc.). During the four quinquennial periods from 1877 to 1896 the average net income per acre per annum for the Prussian State forests was 3·7, 4·1, 4·9, and 5·1 shillings; and though it is larger now than then, it does not necessarily follow that British plantations on waste lands and poor grazing tracts will either equal or surpass in net income the profit earned in Prussia from 12 to 17 years ago. But as the reclamation and planting of waste land has been going on in Prussia continuously for over 55 years, it would have been of special value to have had definite and unprejudiced evidence as to the actual material and monetary results now accruing from these plantations.

So far as their report shows, the Royal Commission does not appear to have attempted to obtain any information on this most important point. Certain data referring to afforestation and planting, I can give you now, however, which will of themselves prove most emphatically that the physical and economic conditions throughout the waste land tracts of Prussia are entirely different from those obtaining in our waste land areas and poor pastures. Between October 1st, 1904, and September 30th, 1907, the Prussian State Forest Department acquired by purchase 46,346 acres of waste land, and planted 33,998 acres with timber trees of various kinds, mostly conifers, at an average cost of 48s. per acre But, besides that, village communes and corporations, and other bodies have likewise been carrying out planting operations, towards the expenditure on which the State also makes a partial contribution. The Prussian Forest Department, to whose courtesy I owe these details, unfortunately did not state the cost of the land acquired; but the planting at £2 8s. per acre is very different from the average of £6 13s. 4d. an acre, which the Royal Commission considers necessary.

The serious position of Britain with regard to timber is perhaps hardly as yet realised generally. Apart from all other timber, in 1907 our imports of rough hewn pitwood came to 2,627,209 loads, valued at £3,049,484, while those of wood-pulp came to 672,499 tons, valued at £3,312,347. These two items alone amounted to £6,361,831, and exceeded in value, the similar imports of any previous year. To supply the demands alone, without making any provision for future increase with increasing population, would need the annual fall from about 3,000,000 acres of conifer and oth r woodlands—that is to say, an annual cut of about 60,000 acres of woods worked with a fifty years' rotation, or of 50,000 acres of woods worked on a sixty years' rotation. The satisfaction of the future demands for pitwood is, surely one of the most important matters connected with afforestation in the United Kingdom. It is probably only a question of time before the large pitwood imports from the French State forests near Bordeaux to Britain must fall off, owing to the increasing demand for, and the decreasing supplies of, suitable wood for the collieries in the interior of France. In coming years the supply of pitwood to British coal mines is likely to cost more; and whatever tends thus to raise the price of working coal must at the same time influence all our industries dependent on coal as part of their raw material for producing commercial articles. The wood-pulp industry (hardly existing in Britain, and only on foreign wood) is capable of enormous expansion, given sufficient supplies of soft-wood; and it is an industry that would spring up in rural districts wherever such raw material could be supplied in large enough quantites. In 1904, mechanical wood-pulp cost in Britain 85s. a ton, in 1908 it rose to 120s. In America its price has been trebled in the last ten years, and everywhere its value is bound to increase greatly in the near future. Pulpwood thus differs from pitwood, for even now fairly large supplies of wood that might well be used in coal mines have little or no value *in situ* owing to the cost of transport to the mining districts.

And last year, a year of great commercial depression, our imports of pitwood and wood pulp were far larger than ever before,

increasing respectively by £313,000 and £843,000, or £1,156,000 in all, over the previous highest record in 1907.

	Year.	Loads.	Value.
			£
Hewn Pitprops or Pitwood	1906	2,451,665	2,713,005
" "	1907	2,617,209	3,049,484
" "	1908	3,041,440	3,579,355
		Tons	
Woodpulp	1906	606,811	2,915,209
"	1907	672,499	3,312,347
"	1908	748,419	3,625,808
		Year.	
Combined value of Pitwood and Woodpulp alone ...		1906	5,628,214
" " " ..		1907	6,361,831
" " " ...		1908	7,205,158

The total value of our wood and timber imports was £27,507,410 in 1906, £27,093,054 in 1907, and £24,306,059 in the depressed year of 1908. Of this total £18,534,958 in 1906, £17,146,823 in 1907, and £14,515,433 in 1908 were for wood "sawn or split, planed or dressed," and at least one-third of this amount represents wages paid to foreign workmen (in addition to the ordinary cost of extraction from the forests), a great part of which might be retained for our own industrial classes if we had the necessary raw material to operate upon.

If our waste lands and poor pastures are at all plantable with profit, it will be in coniferous and softwood crops for pitwood and pulp that the best returns must be sought. Such crops are the most likely to thrive on poor land, cost least to establish, and give the quickest returns. It may be safely taken that 3,000,000 acres of woodlands (chiefly conifer) are the minimum that should be provided either by the State on its own responsibility or in co-operation with County Councils and private landowners.

To carry out a vast scheme of afforestation, such as the 9,000,000 acres of planting which the Royal Commission recommends, three main points have to be taken into consideration:—

1. Money.
2. Land.
3. Labour and Supervision.

1. *Money.*—With regard to providing funds, no suggestion whatever has been made. With an enormous deficit to face, the Treasury cannot possibly grant funds for such a vast and not immediately profitable investment. Probably, the only way in which money can be raised as required will be to form a "National Afforestation Fund" by issuing guaranteed 2¾ per cent stock for the amount needed during each of the next sixty years while planting continues. But why not here look towards Prussia for light and guidance? Parts of the Grunewald Forest, near Berlin, have risen greatly in value, and portions of this are being sold, in order to buy big stretches of waste land for afforesting and planting. Now, the £561,000 a year at present being raked into the coffers of the Commissioners of Woods, Forests and Land Revenues of the Crown are mainly obtained from London house and office property; and as the hundred years leases are now falling in, these most valuable properties can easily be sold to provide many millions of pounds sterling for the afforestation and planting of waste lands and poor pastures, if the Treasury approve and authorise such a course being taken.

2. *Land.*—The Commission estimated that 6,000,000 acres of suitable land are obtainable in Scotland, 2,500,000 acres in England and Wales, and at least 500,000 acres in Ireland, making 9,000,000 acres in all. But the land area of Scotland is only 19,069,770 acres, while that of Ireland is 20,327,947 acres; and to suppose that there is about twelve times as much plantable land in Scotland as in Ireland is incorrect, while it is equally wrong to imagine that nearly one-third of the total area of Scotland is plantable with profit. Over 3½ milion acres are above the 1,500 feet contour; and to assert that nearly two-fifths of all the rest is waste land or poor pasture plantable with profit, must seem strange to those well acquainted with the Scottish hills and moors. Even in the most favoured localities, timber-growing can seldom prove profitable as high as 1,000 feet; and if all the land above that elevation be subtracted, then it will probably be found that 6,000,000 acres represent quite an irrational proportion of the remaining land less suitable for agricultural occupation than for

forestry. And as most of the hill land below 1,000 to 1,200 feet forms winter pasture for sheep stocks, if that be taken for afforestation the whole grazing industry will become dislocated, and the whole of the Highland sheep-farmers will be in a state of political revolt.

But even more amazing than the extent of land considered suitable for profitable planting is the manner in which it is proposed to be acquired. No attempt is to be made to assist and encourage landowners willing to plant, and this is a very weak point in the scheme; because, although *under existing conditions and laws* the State is the only landowner that can afford to create large compact blocks of woodland without desiring quick returns, yet a vast State monopoly of timber-growing can only be justified after the failure of fair attempts at assisting and encouraging private landowners by means of money loans and legislative amendments (*e.g.*, as to settled estates, law of entail, rating and valuation, succession and estate duty, land improvements, railway fires, damage by ground game, railway and road charges, and various other matters effecting land, crops and finance). Under the existing conditions, my own personal opinion (stated on page 93 of vol. i., "The Forester," in 1905) coincides with that expressed by the Commission, and is as follows:

"The necessity for State assistance is a chronic drawback to planting for profit Early in the last century this was just as much the case as it now is Even then, although all the timber, bark and small material from the copse-woods was easily sold at good prices, want of funds prevented extensive planting of waste lands. 'Such lands, it must be owned, are sufficiently abundant, but the great expense and slow returns of planting are inconvenient to the majority of land proprietors. . . . . . The expense of planting is immediate and certain, the profit distant and precarious.' (*Quarterly Review*, 1813, vol x, p. 9).

"This is precisely what the recent Committee on Forestry, 1902, has reiterated. The main drawback to planting is, and has always been, and probably always will be, want of funds; all the other obstacles can far more easily be removed.

"But even if substantial inducements could be offered by Government to private landowners, it would not necessarily follow that the plantations thereafter formed would be managed upon more business-like principles than are the existing woods and plantations. The State is the only possible landowner that can be expected to create large compact blocks of woodlands in the United Kingdom, to be managed on sylvicultural principles, with the twofold object of providing supplies of timber in the future and of fostering and encouraging rural and wood-consuming industries. If this be a duty at all, it is the duty of the State, and not of the private landowner. The State is the only landowner that never dies nor is called upon to pay estate and succession duty, and it is the only landowner that can make large investments without being compelled to desire quick returns in the shape of income; hence, the State is the only landowner that can be sure of remaining free from the temptation to thin timber-crops at an early age and to a great extent—or in short, that can afford to grow the best classes of timber upon rational principles."

Private timber planting has hitherto failed from want of funds, oppressive legislation and financial burdens, want of money, want of systematic management, and over preservation of game (especially ground game). But these drawbacks can be remedied; and till private landowners have been found unwilling to agree to reasonable proposals when made by Government, there seems no justification for the compulsory expropriation of nearly one-third of the whole of Scotland, as thus recommended by the Commission :—

"It will be necessary, at an early stage, for the State to acquire suitable land, and at once the alternatives arise of acquisition by negociation or by compulsion...we therefore recommend that compulsory powers be obtained by legislative enactment, and that a general survey should be made with a view to ascertaining what lands are available for the purposes of State afforestation. These lands should be purchased from time to time as required, the owner receiving in compensation their full value in all the circumstances of each particular case, following the precedent of the Small

Holdings Act, 1907, so far as it is applicable. Compensation should be paid also to sitting tenants"

During the last five months my professional advice has been asked regarding timber planting on several Argyllshire estates, and in each case I have advised the landowner, before committing himself to any such investment, to ascertain from Government what financial and other assistance and encouragement they are prepared to give in this direction. But the recommendation of the Commission is dead against any such assistance:—"In no circumstances, do your Commissioners suggest that the State should be expected to finance schemes of private afforestation, by way of loan or otherwise. The security would not, in their opinion, in such cases, be of a sufficiently substantial kind to warrant such action."

Here again, however, on this most important point, the Irish Forestry Committee gave a different, and a far more common-sense recommendation in the following words:—

"For the larger landed proprietor, the inducement must be of a nature that would relieve him, to some extent, from the immediate lock-up of capital incurred in planting operations, and at the same time provide a guarantee that the outlay would prove, so far as the holding is concerned, a sound investment. Easy loans, with deferred interest, absolute security of tenure in respect of the lands coming under the scheme, and free advice in all branches of forestry, are the chief means which seem to us best calculated to meet this case."

When it seems to suit their purposes, the Commission quote German and French forestry statistics, though they ignore other very relevant data. In both France and Germany the great bulk of the woodlands is in private or corporate ownership:—

	France.	Germany.
	Acres.	Acres.
Woodland area ...	23,400,000	34,730,000
Percentage of woodlands owned by:—		
	Per cent.	Per cent.
State and Crown	11	33
Private landowners	66½	47½
Church lands and other endowments, municipalities, village communals, and corporations	22½	19½

Although both of these countries are devoting large sums annually to the acquisition and planting of waste lands, yet private planting is encouraged, and compulsory acquisition is only resorted to in extreme cases (*e. g.*, mountain-planting in the Pyrenees); and even then the planted land can be subsequently re-acquired by the original owner at its actual cost after the *reboisement* has been carried out. Why should not reasonable endeavours be made in this direction in Great Britain? The Irish Forestry Committee's Report of April, 1908, is much more common-sense in this respect when it advocates the planting of 200,000 acres of State forest in large blocks, and of 500,000 acres by County Councils and private landowners in smaller blocks. And, further, the class of land acquired for planting should certainly not be that having a freehold value anything like so high as £6 13s. 4d. an acre, for many thousands of acres can easily be acquired at about £2 an acre, plus sheep acclimatisation value of about another 5s. per acre, or £2 5s. in all.

3. *Labour and Supervision.*—Even supposing that the £2,000,000 a year, recommended by the Commission to be spent on acquiring and planting land, could be provided, it could not be economically spent at present owing to the Committees' recommendations in 1887 and 1902 not having been acted on. Within the last five years small schools for practical foresters have been formed at the Forest of Dean for England and Wales, and at Avondale (co. Wicklow), for Ireland; but as yet no such school has been established in Scotland, and the only places where more or less systematic outdoor instruction in woodland work is there given are private estates such as Scone and Murthly, in Perthshire. In this respect Scotland is deeply indebted to landowners like the Earl of Mansfield, Mr. Stewart Fotheringham, Mr. Munro-Ferguson, and some others, who have done much to advance the education of forest apprentices. But for a great national scheme of planting a large number of well-trained practical foresters will be required, and such training has not yet been organised to meet the demand that would then be made for men of this class. And the labour difficulty will be enormous. Already in Argyllshire, planters and nursery hands

receive 3*s*. 4*d*. a day, and are exceedingly scarce. Special arrangements would have to be made for planting colonies, while the men engaged would need extra close supervision. No class of work can more readily lend itself to scamping than planting; and if the planting be badly done, then the Commission's sanguine financial forecast becomes utterly impossible of realisation.

Nothing is yet known as to the intentions of Government with regard to either the Irish scheme, or that recommended for Great Britain. In the House of Commons, on February 17th, 1909, Mr. Burns, President of the Local Government Board, said concerning the latter that—

"One of the reasons why the Government did not include afforestation in the King's Speech was, that the Report was only just submitted to them, and was to be read in connection with the Report of the Poor Law. It was a subject that did not require legislation of an elaborate sort, but it did require a great deal of money, and the Government were not justified in including any proposals in the King's Speech in regard to it until they knew what money the Chancellor of the Exchequer would be able to place at their disposal. The thing, however, had passed from an experimental stage, and the Government were seriously considering it with a view to action."

This last official statement was immediately contradicted by Mr. Munro-Ferguson, who maintained that—

"The right hon. gentlemen was entirely wrong in telling the House that afforestation had passed beyond the experimental stage. There had been a few experiments by a few scattered landowners, but the State itself had done absolutely nothing. The State had not only kept its own forest in a most disgraceful state but it had failed, in spite of every kind of pressure, to provide any training whatever either for its own servants or those of the private adventurer. We must at least have two Schools of Forestry and the Government would want about £100,000 to start with."

Now, all that has been done experimentally by Government, was thus summed up by Mr. Pease, Junior Lord of the Treasury, on February 11th, 1908—

"The amount spent by the Commissioners on Woods and Forests during the last ten years, in England and Wales, on afforestation, by which term is meant planting new areas not previously under timber, as distinguished from re-planting old woods, is about £5,000. The cost of land, in England and Wales, bought during the same period for afforestation, is about £1,200 There has been no expenditure on planting new areas in Scotland or Ireland, but £25,000 has recently been spent in buying land in Scotland for afforestation."

Since then no planting has yet been done on this Crown estate of Inverlier, Argyllshire (bought for £25,000); but planting is to begin this autumn, and only 150 acres a year are to be planted for the next twelve years.

And Mr. Burns's statement, that anything like a great national scheme of afforestation is "a subject that did not require legislation of an elaborate sort,' is quite wrong, and simply shows that apparently Government have as yet no proper idea of this subject at all. Very numerous legislative amendments will have to be made in existing Acts (*e.g.*, rights of owner in possession under law of entail in Scotland, and various other Acts previously referred to), which are bound to have far-reaching consequences And the proposal to expropriate for afforestation about one-third of the land of Scotland, must either result in the fall of any Government that is foolish enough to propose it, or, if carried, will mark the first and the greatest step towards an era of Socialism in Britain. And if land is to be forcibly nationalised for forestry, then the ancient royal forests must be the first areas dealt with by the State and expropriated from the Crown.

With both the Irish Forestry Committee's and the Royal Commission's contradictory report before them, it may probably be expected that the Government will desire more detailed information regarding separate schemes for England, Scotland, and Wales. The best way of formulating really sound and practicable schemes is, perhaps, first of all to determine to what Department of Government afforestation work in each country shall be entrusted; and then in each of these three countries to appoint a National

Forestry Board or Afforestation Committee, consisting of representatives of (1) Government; (2) County Councils; and (3) Landowners, Land Agents and Sheep Farmers, to consider and report, whilst simultaneously collecting reliable local data county by county, regarding the amount of plantable land probably obtainable on reasonable terms, and the existing conditions with regard to the supply of labour suitable for planting-work. And if, as should certainly be the case, it be desired to assist and encourage landowners to plant (*e.g.*, by granting loans at 3 per cent. under proper conditions as to security and systematic planting and management, and by lightening the burdens on land put under timber), then such boards or committees will have many knotty points to consider. Thus, with regard to rating, it will not be sufficient merely to exempt the land from rates till the timber crop give good returns, for that would mean throwing an additional burden on the whole of the rest of the rateable land in the county; and the only way of removing a difficulty of this sort will be for Government to give an annual bonus equal to the amount of rate paid until returns are obtainable from the timber crop.

The Royal Commission has not given sufficient consideration to the great practical difficulties connected with hill planting on a large scale. Probably, they had no evidence before them as to the immense jungle of long grasses and weeds that springs up when the sheep are taken off and the area is fenced and planted, and late frosts in spring have done much damage in many recent plantations.

Confining my remarks merely to Argyllshire, which contains much suitable land, an enormous amount of drainage will be needed, for in many parts the average rainfall is near or over 100 inches. And throughout the greater part of Scotland landowners, factors, foresters, and labourers will all have to be educated up to the point of seeing how pernicious on stiff or peaty soil is the now long-practiced, irrational system of notch-planting, unsuitable for any except a very light soil, though it is certainly the cheapest method of planting. "Profitable crops have been raised thus in the past, and why not now?" they ask; or else unfavourable

criticism of this method is met with a cold and rather contemptuous silence. It will take years to educate the local labour up to this point, and it is hardly conceivable that casual labour will, meanwhile, be obtainable either in sufficient quantity or with the necessary skill for this particular kind of out-door work.

Sometimes, also, the objection has been raised that extensive planting would increase the rainfall, impair the climate, and affect the national character. Such fears are unfounded. It is not on local and interior conditions that our damp insular climate is mainly dependent, and by which it is regulated, because the chief factors are the great Atlantic Gulf Stream to which our mild, equable climate is due, and the moist Atlantic winds coming from the south-west, which prevail throughout the greater part of the year. Large woodland tracts would hardly, if at all, increase the rainfall perceptibly, though their influence would certainly tend to increase the relative humidity of the atmosphere in the vicinity of the forests; but any drawback which might possibly thus arise (and this it would be difficult to estimate beforehand) would certainly be far outweighed by the additional shelter they would provide for grazing stock, and by the water-storing capacity of the woodlands, and the immunity against inundations that this tends to provide. The heaviest annual rainfall in the British Isles is in Cumberland (Styhead Pass), but is the character of Cumberland men, therefore, impaired on that account? Or has that in the slightest degree dulled their natural shrewdness or their business instincts and capacity?

In conclusion, it has often been asserted that extensive planting would interfere greatly with sport. If the bare Scottish deer forests were covered with woods, the character of the sport would certainly be changed; but it is far more likely that the sport would be improved than deteriorated thereby. Any closer consideration of this particular point, however, would only unnecessarily extend this already long paper.

DISCUSSION.

Sir HERBERT MAXWELL, in opening the discussion, said he had been much impressed by the view taken by the author, of the possibilities of an industry which was

essential to the future of all other great British industries None of the principal industries of this country could subsist without an ample and reasonably cheap supply of timber. He had taken out the figures of the timber consumption in this country and the rise in price during the twenty years from 1886 to 1905, and he found that while the import had risen 90 per cent., the average price of timber had risen during that period 22 per cent. He thought it was a very grave consideration for the manufacturers of this country how far any of the industries could face with any confidence a further rise of 22 per cent during the next 20 years: it would be almost prohibitive. The foreign supply was not likely to get larger, the accessible forest in the world were disappearing, and the price was rising steadily. During the more than 20 years he had been a railway director, the companies had had to pay more heavily each year for their timber supplies. It might be said that the price of British timber had diminished, but he thought there were conditions affecting the home timber trade which did not give quite fair results. In the first place there was the very irregular supply, for which the producers were to blame. The author criticised very severely the findings of the Royal Commission. Personally, he agreed with a good deal that had been said, especially that it would be ridiculous to expect to rear profitable woodlands above the thousand feet level in Scotland ;- but he did not agree with the author that the British Isles were more liable to gales than the Continent. This country suffered more from them not only because of the way in which the woodlands had been planted, but because of the drastic over thinning to which they had been subjected. When the Romans landed in this country 2,000 years ago, everything under the thousand feet level was dense forest from sea to sea, and there was no meteorological reason why, except on the exposed seaboard, that should not be the case again. One point in the Royal Commission's Report was worthy of special attention, the social point. It was brought out in Dr. Schlich's evidence how closely the forestry industry was associated with small holdings in Bavaria and Bohemia, the men who worked on their small holdings of from one to ten acres during the summer, finding constant employment in the forest during the autumn. The very large proportion of crofters who had claimed and obtained pensions in the West Highlands under the Old Age Pensions Act, on the ground of the inadequacy of their living, showed what a low level of subsistence was attained by people dependent only upon arable land in very small portions Apart from the economic consideration of the question, of which he did not take so despondent a view as the author, it was worth the attention of the rulers of this country, not to put people back on the land, which was a hopeless business, but to keep them from leaving the land, by providing, in forestry, a source of winter employment. As the forest grew to maturity, many other subsidiary industries would also grow up. It was in that direction they most hopefully looked, not only for the success of the subdivision of land into small holdings, but also for maintaining a vigorous and healthy population upon the land

Mr. H. J. Elwes, F. R. S., said the paper was practically a criticism of the Report of the Royal Commission. He could not conceive how men could have been appointed by the Government to enquire into a subject, who carefully avoided calling a very large proportion of witnesses who could have told them what they wanted to know. As a matter of fact, the Commission was appointed for a different purpose. It would have been supposed that whatever might be said against the landowners of Great Britain,

at least they or their agents could have given the Commisson more practical knowledge on that particular question than anybody else It was ridiculous to enquire into such a subject without going to the men who really did know. Speaking from the point of view of the English landowner, he agreed with almost everything the Chairman said in his opening remarks, because it was necessary not to mix up the two questions of unemployment and forestry, which had absolutely no connection. He had employed agricultural labourers who were out of work in the winter for afforestation purposes, and it was the most costly and unsuccessful experiment he had ever made. The point the Commission entirely overlooked was, that where unemployment was rife there was no land capable of being acquired at a price, or which was suitable in its character to grow profitable trees. Trees of a sort could be grown on almost any land, but it was impossible to grow trees that would compete with imported foreign timber, on the land the Government expected to buy at £ 2 an acre. In the Appendix to the Report of the Commission, the six gentlemen who were sent out into six different districts in England to search for land, stated that they could not find any. It was impossible to find in those reports a single instance of an area of 1,000 acres in a block which they were able to select as likely to prove an economic experiment for the Government to undertake. He was not referring to Scotland, Ireland, or Wales, where there were many thousands or millions of acres available, if the people would only give them up. The whole bottom was really knocked out of the Report. In the first place the premises in the financial part were rotten, because they were based upon conditions derived entirely from Germany, where neither the social, climatic, geological, nor any of the other conditions applied. A good deal of private property would be found in Germany and France which had been just as badly managed as English woodlands for precisely the same reason, namely, that it paid better to have lots of game than fine trees. Any practical valuer or land agent would give the opinion that it was ten times easier to sell a good sporting property, with a lot of ornamental and artistic timber upon it, than it would be to get a single bid for the most perfect 10,000 acres of German pine forests that ever existed. It was impossible to pretend that this country could ever compete with the North of Europe in the production of timber. Woodpulp might be made if the water-power was available, but it could not be found close to sufficiently large areas of land where the pulp could be grown; and, even if it could, it would be found that, owing to cheap foreign labour, pulpwood or pitwood would be imported into this country at a cheaper price than it could be grown 30 or 40 miles off the from place in England where it was to be used. He could not personally compete with pitwood imported from Bordeaux, even in a district only 20 miles distant from his land. English plantations could not profitably be extended on poor waste land that could be bought at £2 an acre. Much more good would be done by growing hard woods, such as elm, ash and oak, on better and and in places where they were wanted, than by trying to cover a lot of barren mountains, in the very few parts of England where such existed, with timber of a cheap class which could never be grown at a profit. If, however, inducements were given to English landowners to grow timber, they could grow it as well as the Germans, but they must receive fair play, and it was impossible to say that was given to them with the present system of taxation and rating on woodlands. It was necessary also to have fair railway rates, there being nothing as grossly unfair in England as the preferential railway rates which were given to

foreign timber. As long as such unfair conditions existed it would be impossible to have anything like the expansion of plantations that he would like to see. By the Report of the Royal Commission, this country was asked to raise funds for the benefit largely of Scotland. Supposing that even one-tenth part of the recommendations of the Commission were carried out, the market would be entirely destroyed for all private growers of timber in England. If the timber merchants of England knew that the Government must cut down the timber on their land and sell it, they would offer a ridiculous price for it, because the Chancellor of the Exchequer would not be able to wait and hold back the timber for a favourable market. Although he admitted that the price of timber was likely to rise he thought it would not do so as much as some people expected. It was time the true facts of the case were brought to the notice of the Legislature, before they landed the country in such a gigantic gamble as the scheme of the Royal Commission proposed.

Prof. J. B. FARMER, F. R. S., emphasised the necessity of an improvement in forestry education in this country, which, he contended, was lamentably behind what it ought to be. He had been glad to hear the author make such strong protests against purely theoretical teaching, having always felt that demonstration areas were of supreme importance in this country, because of the knowledge of local conditions which was thereby obtained. He did not depreciate the value of the instruction imparted at the great forestry schools such as Munich, but the conditions there were totally different from those obtaining in this country, where it was necessary to provide areas in which foresters could be definitely trained under the conditions in which they would have to work. Forestry must be treated as a kind of intensive cultivation, and there ought to be a school of forestry in this country on an experimental scale, which did work similar to that which Rothamsted carried out for agriculture. There was a school at Oxford, and others had been begun at Cambridge, and elsewhere, but through the lack of experimental stations, they were not nearly so efficient as they might be.

The CHAIRMAN (The Right Hon. Sir Charles Wentworth Dilke) in proposing a cordial vote of thanks to the author for his exceedingly interesting paper, regretted that some one had not attended the meeting to represent more strongly than had been the case, those people who were desirous of trying a large afforestation scheme in England, because it would be admitted that it would be impossible to make it a national scheme if it was to apply to Scotland and Ireland only; the English case would have to be faced. He contended that coniferous timber could not be grown to pay in England, even larch. It was impossible to find any but exceptional places in England where either larch or spruce could be grown without draining the ground. The land always appeared to be either subject to occasional droughts during which the trees died, or if it was fairly watered ground the odds were that the roots got into peaty stuff, so that moss was produced upon them, and that trees could not therefore be produced to pay. Reference had been made to the Dean Forest School, which was under very good control, and if only people would begin to draw foresters from it, it would soon spread. This country had been horribly backward up to the present time, and it was only within the last few years that a school of assistant woodmen had been produced who could tell the difference between Pacific Slope Douglas and the Colorado Douglas, two trees which were botanically the same, but which for the purpose of growing timber were as different as chalk from cheese. With regard

to demonstration areas, he believed that for oak forest, there was nothing so good in England as the High Meadow Woods, under Dean Forest management, which were by far the best oak woods in this country. On the other hand, such a demonstration area should include a portion showing the worst possible growth of oak, and that was also in existence in what were known as the orchards, the oak trees in which looked like small apple trees of very ancient date. As a result of the enquiry previous to the recent Royal Commission, Alice Holt was produced as a demonstration area, though also an example of what to avoid and not to follow. The Crown forests were originally planted for the supply of oak timber to the Navy, and it had always been frankly stated that the question of profit was not seriously considered, it being merged in the question of the necessity of providing for national defence. In recent times there had been a great improvement. The only large oak wood in England was Dean Forest, which contained —including neighbouring Crown freehold—19,000 acres of unbroken oak forest. There was no doubt that the growth of oak would pay the Crown, and so, perhaps, would ash and other timbers. He had particularly wished to hear something with regard to Douglas fir, because the enormous bulk of the evidence of the last Royal Commission relied mainly upon that timber: but there was nothing like a proof of success, except in a few cases in Scotland.

MR. ELWES, interposing, said he gave very complete statistics, in his book, with regard to Douglas fir, at four English places.

THE CHAIRMAN, continuing, said that one of the questions on which information was required was, what chance there was of growing pulp timber at a profit in this country. A good deal of the case of the Royal Commission was based on the assumption that the production of pulp from other countries would so greatly fall off, that pulp would fetch a price which would enable it to be grown here. Of that he was profoundly sceptical. With regard to pitprop timber, it was not all drawn from a single kind of tree or country. Different kinds of pitprops were required, some holding tight as long as possible, and others yielding gradually to pressure, until the whole of the vacant space was filled by the weight of the rock. The production of the French forests was not declining, but, on the contrary, increasing and keeping pace with the demand. The pitprops obtained from Western France were only in the nature of a by-product, turpentines and essences first of all being extracted from the tree. Again, there was an infinite supply of wood of the same inferior kind entirely untouched in Corsica and other places on the borders of the Mediterranean. He had recently discussed the question of pulp timber with experts, and many denied that a permanent falling off in it was likely. It was necessary to get some facts with regard to the possibility of growing pulp profitably in this country. Anybody could grow spruce for Christmas trees, but when they passed an age at which a magnificent profit could be made on them, if a market could be found, English spruce was apt to be conspicuous by its inferiority. People had not learned to grow spruce in this country, and that tree was probably not suitable to it. The Corsican pine had not been mentioned. This tree on inferior soil both in England and in Belgium, on sand, yielded good results. It was a prey to the attacks of the pine-shoot beetle, although less than was Scotch. As a matter of fact, all failures were excluded from the volume of evidence, and the question of the ravages of the pine-shoot beetle was conspicuous by its absence. Such insect

pests could be stamped out, but, as with drainage to prevent mossiness in spruce, the triumph of man over Nature was too costly for the financial scheme. Neither the Government nor the Counties could be expected to go into speculations of the kind suggested unless a fair financial statement was produced, showing that they had at least some chance of getting their money back.

The resolution of thanks was then put, and carried unanimously.

Dr. NISBET, in reply, said the discussion had proved more clearly than before that what was required was not a general scheme, but that each country must consider a scheme for itself. Evidence had been adduced showing that England was not at all suited for the conditions that had evidently been in the mind of the Royal Commission. There was no doubt that a far better class of land was required to grow oak than waste land and poor pasture; but even on such lands in Scotland, when once woodlands were well established, ash and other hardwoods grew freely, and they were much more likely to pay in those parts than if they were planted on bare hill sides. With regard to the question of pitprops, if the price of wood went up it must necessarily affect all the industries of the country. That was particularly the case with pitwood, because coal was the raw material for nearly every one of the British industries; and whatever tended to force up the cost of working coal must have a very bad effect on British trade and commerce. It was an open question whether greater damage would be done by gales in the British Isles than on the Continent. This country did not possess such extensive forests, so that it was impossible to say from experience what effect would be produced. The climate of this country was certainly more favourable to the growth of timber trees than the Continental climate; but it must not be forgotten, also, that its mild equitable climate, with the long autumn and spring, was at the same time more favourable for the fructification of fungi, and that late and early frosts do more damage here than on the Continent. Unfortunately, the Douglas fir in Scotland had, in a good many instances, been attacked by a rather serious fungus disease, which might possibly become of the same importance as the larch canker. Menzies spruce was also not exempt from the disease, and it would be a great misfortune if large plantations were made without proper experience being acquired by experiment as to the proper soils, situations, and methods of growing those valuable timber trees. Whatever might be the case in England, spruce and silver fir grow well in Scotland, and up till 60 or 70 years of age would probably give good returns for pulpwood. Spruce, undoubtedly, grows better in the north and west of Scotland than anywhere in England. With regard to what Sir Herbert Maxwell said of the great advantage that would be obtained by keeping the people on the land, even in Germany attention had been drawn in the Reichstag within the last three weeks to the growing difficulty of the problem of retaining men on the land, even in the forest areas, where constant work was obtainable. The men had begun to show a desire to drift towards the towns, but extensive forests would do as much as anything to counteract that desire. It seemed to him that England, Scotland and Wales ought to appoint separate Committees, similar to the Irish Forestry Committee, to deal with the local conditions, and that far broader views, with regard to the ownership and management of new woodlands, should be taken than was the case in the Royal Commission's report.

ORIGINAL ARTICLES.

CALCULATION OF POSSIBILITY FOR SELECTION FELLINGS

In the *Indian Forester* for April 1907, there appeared a letter from "Forester" complaining of the confusion that often exists in working plans, between minimum and mean exploitable size, when sal forests are being worked under the selection system.

That our forests are still in danger of being overfelled by reason of this confusion will be apparent from a plan which is under consideration for the Bahraich forests of the Eastern Circle, United Provinces.

In this plan the girth classes adopted are :—

6′ and over – I class.
4′ 6″ to 5′ 11″ – II class.

It is assumed that a II class tree becomes I class in 30 years, and 6 ft. is taken as the minimum girth at which a tree may be felled.

Putting aside sylvicultural considerations and abnormality of age classes, and assuming that a 5′ 11″ tree will become 7′ 5″ in 30 years, the argument on which the possibility is based may be stated as follows :—

(*a*) If it be found convenient to work over the whole area every year the normal exploitable stock at the commencement of any year's fellings will be only those trees which have reached 6 ft. during the past year and all of these may be felled. Any existing stock of larger I class already standing on the ground is a surplus and may be removed in any convenient period. It follows that at the end of that period the mean girth of exploitation will have been fixed at 6 ft.

(*b*) If it be found convenient to work over the whole area in 15 years a certain accumulation of I class trees, say *n*, is necessary at the commencement of the period. If the actual number of I class trees existing is found to be *n* + *m* then *m* I class trees constitute a surplus to be removed in any convenient period. Then at the end of that period the mean girth of exploitation will have

been fixed at 6′ 3½″, since in any period of 15 years the II class trees passing up will only attain to girths of 6′ to 6′ 8″.

(c) If a 30 year period is adopted the mean girth of exploitation will eventually be 6′ 8½″.

The plan in question, as regards the Motipur and Sohelwa sal working circles, adopts (*b*) and thereby fixes the mean girth of exploitation at 6′ 3½″.

It is not possible or necessary here to enter into the question as to whether 6′ 3½″ is a suitable mean for these forests, for the fallacy is one of principle in allowing the mean girth of exploitation to be decided by the minimum girth and by an arbitrary fixing of the felling period, based on the convenient size of coupes, instead of making the most desirable mean girth the basis on which the whole calculation rests. If, for instance, a mean girth of exploitation of 6′ 8½″ (*i.e.*, trees 6′ to 7′ 5″) be desired and also a 15 year felling period, then half the I class trees existing at the commencement of the period must be retained at the first felling in view of the fact that the coupe is doubled in size and that after only 15 years the maximum size of II class trees passed up will be only 6′ 8″.

In all the circles, the calculation of possibility is made without reference to the resulting mean girth of exploitation and is based entirely on the minimum girth and the arbitrarily fixed felling period.

For the Sohelwa working circle the only reference to exploitable size is a statement that 6ft. is the minimum, showing that the influence of the maximum on the mean girth has been overlooked, the maximum being of course determined by the felling period provided that it is assumed, as in the Bahraich plan, that every I class tree is exploitable at each felling.

As has already been shown, this minimum of 6 ft could be maintained if all the existing I class trees were felled in a single year.

In the *Indian Forester* for November 1906 appeared an interesting article on improvement fellings, rightly maintaining that this term should be confined to clearings, weedings and thinnings

and should not be allowed to become an accepted system for main fellings. As a system of main fellings the so-called improvement system is exactly what the writer stated, *viz.*, a debased selection system in which the possibility is fixed by area only and in which there is no check possible on such a lowering of the mean girth of exploitation as I have described above, due to felling an unfair proportion of I class trees in a felling period shorter than the time it takes for a II class tree to become I class, nor any check on removing too many II class on the ground that they are deteriorating.

In the Bahraich plan we have a new monstrosity described as improvement with selection We have already seen that under the selection part of the system a very full and possibly excessive possibility of I class trees has been worked out. This possibility rests on the assumption that 80 per cent of the present II class will become I class in 30 years, and 75 per cent of the present III class will become II class in 30 years.

Then, under the improvement part of this system, there is the well known prescription that an unlimited number of inferior II class sal may be removed if thought desirable. What guarantee can there be that the trees that dry up and the trees removed under this prescription will not exceed 20 per cent of the II class trees in 30 years? Here we have one of the principal evils of debased selection grafted on to true selection and the value of the enumerations practically thrown away.

It has several times been debated in the *Indian Forester* whether enumerations are necessary or worth the expense, but I think the majority prefer to have some definite basis for prescriptions and to be able at least to make an attempt at equal outturn.

There would seem, however, to be a strong tendency to nullify the value of enumerations by some extra prescription like the above, which has not been based on them.

NOTE.—The girth classes adopted in the Bahraich plan lead to the inconvenient fractions shown above, in calculating the mean girth of exploitation.

To avoid these fractions the classes should be 4′ 7″ to 6′ = II classes
over 6′ = I class.

F. F. R. CHANNER, I.F.S.

NOTE ON THE WILD ARROWROOT LILY OF MAHABLESHWAR IN CONNECTION WITH THE PAPER MAKING INDUSTRY.

Dalzell calls this plant *Curcuma caulina* while others prefer *Hitchenia caulina*. The native has named it *Chávar*.

The stem is leafy, the tuber perennial and smaller than the fist, leaves entire, lanceolate, measuring 15" × 6½", lateral nerves 40 to 50, midrib pale, suppressed, bracts large, green, inflorescence terminal, flowers yellow on a slender tube. Sir J. Hooker says the *habitat* includes the Konkan.

The plant shoots up towards the end of June, that is, after a few showers of rain and flowers during July and August. In exposed, dry places the leaves, which usually number five or six, wither during November; in shady, moist, localities green leaves may be found in December.

The wild arrrowroot lily grows in abundance on the Mahableshwar Plateau and is noticeable everywhere except on very rocky soil. A plant growing in such abundance and possessing such large leaves, must do a vast amount of good in preventing excessive erosion in a locality with an annual rainfall of nearly 300 inches. The enormous quantity of dry leaves of *Hitchenia caulina* lying everywhere after December on the forest floor, forms food for forest fires.

In former days, natives utilized the tubers for the purpose of preparing arrowroot, which was made by a slow and lengthy process of soaking, straining and drying; but this industry has now been almost abandoned by the local inhabitants owing to its unprofitableness.

Authoritative information from Calcutta encourages the hope that the leaves of this plant may yet prove of great utility, as far as the paper making industry is concerned. It is, therefore, natural that those interested should now begin to consider when the leaves ought to be cut, that is, the season when the greatest advantages will be derived.

For the reasons stated below the middle of October is suggested, and if this suggestion be accepted, the preservation

and removal of the leaves will serve no less than six purposes, namely :—

(*a*) being allowed to remain during the monsoon the plant will act as an excellent soil protector ; and

(*b*) will also protect young seedlings from damage by violent rain ;

(*c*) the removal of the leaves in the month above noted will result in diminishing the quantity of inflammable material on the forest floor, and will thus aid in diminishing the intensity of a fire, in other words in decreasing the harm done by fire ,

(*d*) the necessary material for paper-making will be supplied ;

(*e*) the plant will have seeded ; and

(*f*) last, but most important, the tubers will be allowed to store their maximum quantity of nourishment, and they will thus be in a position to yield a normal crop of good sized leaves the following year.

J. E. C. TURNER,
Forest Ranger.

USE OF BANPU BARK *(TERMINALIA TOMENTOSA).*

Apart from its commercial use for tanning and sometimes for dyeing, there is a distinct use made of it in this Range probably throughout the District also, *viz.*, for preparation of lime to be used with *pan* (betel leaf).

When, recently, I was inspecting certain blocks near Darmastala, I observed about a dozen Banpu trees close to the block having been stripped of their bark. My first impression, from a distance, was that the trees had been girdled with a view to kill them. But it was not so, for in the first place the trees were very young being nearly all in the pole stage, and secondly, it was not regular girdling, as only the cortex portion had been stripped off all round the tree for about 2 to 3½ ft., at a height of 3 ft. from the ground, thus leaving the cambium larger; and lastly, on close examination some more trees were found which had been subjected

to the same process in previous years, but these were quite alive and apparently unharmed, as the wounds had completely healed over with new cortex.

On enquiry and observation, I discovered that the removal of the bark of (*Terminalia tomentosa*) Banpu is being systematically carried on in this way for the extraction of lime for the special use of Jains and Brahmins to eat with *pan*.

Method of preparation.—Bark is collected, dried in sun and burnt to ashes in the open. Banpu leaves are collected, chopped to pieces, and a hot thick decoction prepared from them by boiling them in water After removal of the leaves, the burnt ash is thrown into the hot decoction and well mixed. This is kept for ten days, by which time the whole becomes a solid mass It is then made into small balls, which are pressed flat by hand. Each of these is then placed between two cowdung cakes which are well pressed together. A small pit, 2 to 3 ft. in diameter, is dug in the ground A layer of cowdung cakes being first put at the bottom, the pit is filled with the cowdung cakes containing the ash discs and then set fire to the cowdung cakes become burnt to ashes, but the ash discs remain intact, having been completely burnt to a red brown colour. These are collected and placed in a pot containing water which is then well stirred. The solution having been filtered two or three times to get rid of sand particles and other impurities, is left to settle. A residue of very soft lime is deposited and this is used with *pan*.

Only Jains and Brahmins of these parts prepare and use this lime. Owing to religious scruples, they prefer it to ordinary lime from shells or stone, which is generally used by others.

The exclusive use by Jains and Brahmins is a noteworthy point as far as the Forest Department is concerned ; for wherever the Banpu trees are found with their bark stripped off, it is fairly certain that a Jain or a Brahmin living close by must be the culprit.

DHARMASTALA : N. S. NARAYANA AIYANGER,
Uppinangady, S Canara. *Forest Ranger.*

A Cold-Weather Buffalo.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

A COLD WEATHER BUFFALO.

EXTRACT FROM DIARY.

December 16th. Moved camp to Esli, where I am halting, some half mile from the village and tank. Latter quite a fine one, with a lot of whistling teal thereon. Had a few shots in evening, but owing to the coolies not turning up with the donga, only managed to retrieve 5 out of 11 birds.

Sent Kama out to look for tracks, he could however find no newer buff tracks than 3 days old.

17th Carts went off to Damarincha. Self and Kama in a double donga started before daybreak to try for buff on the opposite bank of the river. Day had only broken some half an hour, and we were drifting down river edging into the opposite bank, when a man in a donga passed up, shouting to Kama that some big animal was moving in the jungle just below. Two minutes later K. was making frantic signs to me to grab my big rifle (the 600 Cordite.) Luckily I'd just filled my pockets with cartridges. Looking ahead I saw a fine solitary bull buffalo, feeding close to the edge of the river. Here I must mention that a steep sandy bank, some 15′ high sloped down to the river. There was a small ledge about 2 feet broad, and then the water started sheer at 3 feet depth. Above lay thick jungle. When first we sighted the bull we were about 100 yards off, and as the morning mists were still rising slightly from the water, nothing could be seen very clearly. I waited, rifle ready, in tense expectation. K. crouched down in bows, hardly breathing, while the two Dimars in rear sat motionless save for an occasional swift stroke with paddle, 90 yards, 80 yards, 70 yards the bull still unsuspicious, 60 yards, then something disturbed him and he turned and without haste started to climb the steep bank. The boat glided almost motionless, some 50 yards separating us, then after careful aim I gave

the bull the left barrel behind the shoulder. He staggered, the right barrel followed, then like a fallen tree he collapsed, rolled down and with a mighty splash plunged into the river. But the cold water evidently revived him, and he made enormous efforts to climb the slippery bank. Re-loaded I again fired, and he slipped back into deeper water. But he was by no means done yet, tho' blood was pouring from his neck, and his snorts were terrific. Just as he got half on to the bank I fired again, but he slipped at the same minute, and the bullet ricocheted in the water. A second bullet shared the same fate, as the boat, now within 20 yards, was rocking violently. It was no use wasting cartridges, and as the bull seemed done for, the boat was sent to land some 20 yards above him, and I took the 12-bore shot and ball gun, with two spherical bullets in, and walked along to finish him. Kneeling, I gave him the left barrel behind the ear, it stunned him for one second only, then turning he saw me. His rage apparently gave him strength for a last effort, and hurling himself almost out of water he tried to reach me, but the second barrel at 2 yards thro' his skull ended all, and he fell back making a minature maelstrom, as he died hard. Poor brutes, their vitality is enormous, and they *do* die game. His half charge seemed to have scared my followers badly, as K. bolted like a rabbit, and the Dimars with craven spirit had hastily pushed off into deep water. With great difficulty we towed him across the river, and then sent word to Esli. Later, half the population turned up, and those castes who would eat him, all bore knives, and were full of genuine gratitude for the feast that loomed ahead.

SKENE-DHU.

THE BURMA MOLE RAT.

Have any of your Burma readers considered the Burma mole rat and its methods, as factors in the reproduction of teak and incidentally of course of other species? Not only have I seen no mention of this little beast in any book or notes on Forest Zoology, but Mr. Stebbing, in a very prompt reply to a query of

mine, writes to me that he "has no information on the effects of the presence of this rodent in forests." I am thus induced to rush into print and give you a few notes based on personal observation. In common with most of your readers who hail from "Golden Burma" I had almost daily noticed, when on tour, the numerous mole hills come across in forests and garden land, practically throughout Lower Burma, but had paid little attention to them till I was bitten with the rubber craze and started a small plantation of Para in the Tavoy District. Then, indeed, was the devastation brought by this little pest brought vividly home to me. The damage done is very considerable, and the expense involved in trying to get rid of them also considerable, as they are by no means easy to catch. Their life is spent entirely under ground as far as I can gather: I have never yet come upon one in the open. We have all, when padding through a forest at night, especially in the hot weather when the slightest rustle sounds sharp and clear, heard the skurrying away from the path of terror-stricken little bodies. Although the movements of these always struck me as too rapid for those of mole rats, curiosity has taken me out on several nocturnal trips with an acetylene bicycle lamp to try and identify these wee night prowlers. I have come across the large bamboo rat, field rats and mice and shrews but never a mole rat yet. Their *modus operandi* is to gnaw through the root just below ground-level, consequently, species with a well developed taproot and few lateral roots of any size in their early stages, such as teak and Para rubber, when the damage has been done, fall over altogether or at such an angle that the attacked tree is evident at once. In the case of older rubber trees which have developed fairly sturdy lateral roots, which keep the tree in an exact position, these do not die but after a period, more or less prolonged, of decided check flourish and do well for a season at least, but I fear the damage has been too severe for the tree ever to reach maturity owing chiefly to attacks by fungus and white ants.

In the case of smaller, one year or two years old, plants, not only is the root gnawed through, but as this occurs the plant slips

down two or three inches in the burrow. This two or three inches is then bitten and gnawed, and another two or three inches slips down, and so on, until often there is only the top whorl of leaves in the case of rubber and a leaf or two when a teak tree has been the object of attack If, however, during this gnawing and pulling or slipping down process, the plant attacked bends over to one side or another, thus stopping the slipping down process, further attacks cease. It is this act that makes me inclined to agree with some of my Burman friends that our little enemy does not deliberately look for tree roots for food, but simply eats them through to remove obstructions in his burrow, and because he *has* to gnaw to live as he is a rodent and, in common with all such, their teeth have to be kept worn down or they will eventually grow into a circle, having been known in the case of the lower incisor, to curve right over and penetrate the top of the skull when the owner has been prevented from gnawing by accident or design. I am not quite sure yet on this point. In the case of rubber trees, having regard to the large proportion attacked I had grave doubts for a long time as to whether these were not systematically searched for and their somewhat tuberous sweet root fed on. It is very hard to identify, without the must careful analysis, the contents of their stomachs. They are typical nibblers and reduce their food very fine before swallowing. Two I kept in captivity for three months, I fed entirely on cockchafer and borer grubs, earth worms they would not look at For two weeks I kept them on this soft food and then introduced two taproots and two stems of Para rubber plants (1½ year old). There seemed to be no discrimination, they eagerly and at once attacked the nearest to them and gnawed away merrily for hours until they had gnawed, bitten and mangled the lot

There was a large amount of fibrous *debris* but the conclusion I formed was that the gnawing was not done for food but to keep their teeth in order.

They are quite interesting pets in a way and take to captivity fairly kindly, quaint little animals covered with soft, dark grey fur, small beady eyes, nose blunt and fleshy rodents, teeth, movements slow above ground but such rapid burrowers that coolies with

mamootees or dahs cannot overtake them. They are generally found in pairs or singly and never appear to have two at a birth. I have only found one in each of the three nests I discovered. My Burmans' theory was that there were two but that the mother had carried one out of danger further up the burrow and had not had time to come back for the other.

There seem to me to be two very closely allied species, otherwise I cannot account for the small tuft of white hair on the foreheads of some and not of others. I at first attributed this to sex or age but have had to give up that idea, as I found the tuft present or absent on both sexes and at different ages.

They are pugnacions little beasts and evidently not gregarious. Two put together, directly they come in contact, go for each other at once with an extraordinary wheezing, grunting, purring noise if you can imagine such a combination. They do the same when stirred up with a stick or teased at all. Their burrows sometimes go more or less straight for quite long distances, at others ramify about in the most extraordinary manner, I suppose when they have hit upon a good feeding ground. I had two or three get into my rubber nursery and they played havoc in a few nights biting off and gnawing through some 300 one year old plants. Mr. McIntosh, D. C. F., tells me he found them doing considerable damage to teak plantations in the Minbu Division and I have found the same both in young teak plantations in the Tharrawaddy District, and also to advance growth, in both protected and unprotected areas. Mr. Nicholson reports them as damaging his mango and jack trees in the Kyaukse District. Mr. Agar and Mr. Hearsey are troubled with them the Shwegyin District, and in fact they appear to be pretty generally distributed throughout except in the Mergui district, in parts at any rate. Mr. Finlay of the Burma Para Co. tells me they have none on their King's Islands plantation and Mr. J.W. Ryan, Extra Deputy Conservator, tells me the same as to the Government rubber plantations near Mergui. These two large plantations are immune, probably because they are both on decided islands. It would be interesting to know, however, if they are found on the adjacent mainland.

They do not affect any particular soil. I have found them in sandy loam, hard, stony and gritty gravels and in shaly and heavy clay. During the rains you will find fresh burrows at the tops of hills of quite respectable dimensions and all over the forest practically. In the hot months they begin to descend and their little hill (for all the world like a home mole hill) may be seen in thousands in the damper low-lying forest, along the banks of streams and in deep shady valleys. Although, as I have said, they cannot be called really gregarious, the force of circumstances in the dry weather drive them to certain localities on which, as I have said before, their traces can be seen in thousands and I have very little doubt that the comparative absence of teak reproduction and advance growth, in what seems particularly favourable situations, may be attributed in part at least, to their ravages.

The subject is a most interesting one and deserves attention, I think, as does every factor which militates against teak regeneration. So far, I am unaware of any natural enemy to the species except possibly snakes, and in a small degree, man. The Karens and most Burmans, eat them with avidity and declare them "good" which I can well imagine they are, as they invariably seem in good condition and often are regular little balls of fat.

I have not been able to get the species identified Mr. Green of Peradeniya, wrote me that he thought it would be the *Nesocia hardwickei* but was not certain and asked for skins and skull which I sent to him only to have the Burma Post Office refuse to forward them as they came in the Prohibited List under "skins". An appeal to the Post Master General was useless, and what eventually became of the package only the postal people know and they won't tell! However, if you wish I can easily get you more and send them also, the whole animal, or better still a pair, in spirits. They are not hard to catch actually, but although there is a standing reward of 8 annas per head on several rubber plantations in Burma, I have not heard of any Burman amassing riches at the game. An offer of four annas per head produced none, doubled and they began to come in at the rate of 15 to 25 per month, off an area, be it noted, of 150 acres only. The species does not appear

to occur in Ceylon, the Malay States or India, but is found in Burma and western Siam.

They are caught by digging and following up the burrow until it takes a distinctly downward turn, then a bucket or two of water poured sharply down brings up very miserable bedraggled looking individuals.

Again, the ordinary 2" gin put in the mouth of the burrow and left during the night generally is successful, if the burrow is a fresh one, and a third method is to dig down along the burrow as above and then stand over it with a rice-pounder and mamootee. After a more or less prolonged period, the little brute comes slowly and cautiously along and starts filling up the mouth of the burrow with freshly excavated earth Down comes the rice-pounder or other implement and either smashes him up or cuts him off from his burrow when his capture is easy. This last method seems most successful in the rains, as the mole rat appears to loathe wet as much as a cat does. The heavier it is raining the sooner, as a rule, does he come up to close the door.

ZIGON, THARRAWADDY: "BURMA."
February 24th, 1909.

DEATH OF A NILGAU FROM EATING HAIR.

On the 20th March 1909, a tame blue bull or Nilgau *(Portax pictus)* died at the age of 3 years. On being cut up, eight dusty brown coloured balls were found in its stomach. These balls were brought to me as a curiosity. They were like cannon-balls in appearance and were so hard and stiff that they could not be broken or even flattened with a hammer. I then had one of them sawn in two, and found that it was composed of a compact mass of hair, probably human hair, surrounded by a leathery outer covering. It is surprising where the animal could have found so much hair, and the only explanation seems to be that, as it used to roam freely wherever it liked in the village, it used to lick up the human hair thrown away by barbers. In fact, some of the villagers afterwards stated that they had seen the animal doing this.

Four of these balls were from 19 to 21 inches in circumference, and weighed 2 to 2½lbs., while the remaining four were 13 to 15 inches in circumference, and weighed over half a pound. The shikaris around here say they have never heard of any such instance before. It would appear that death was caused by this great accumulation of hair which the animal was unable to digest, but the wonder is that it lived long enough to accumulate such a mass.

DEORI, C. P. RAGHUBIR SARAN MITAL,
14th May 1909. *Range Officer.*

(a). An unprotected area.

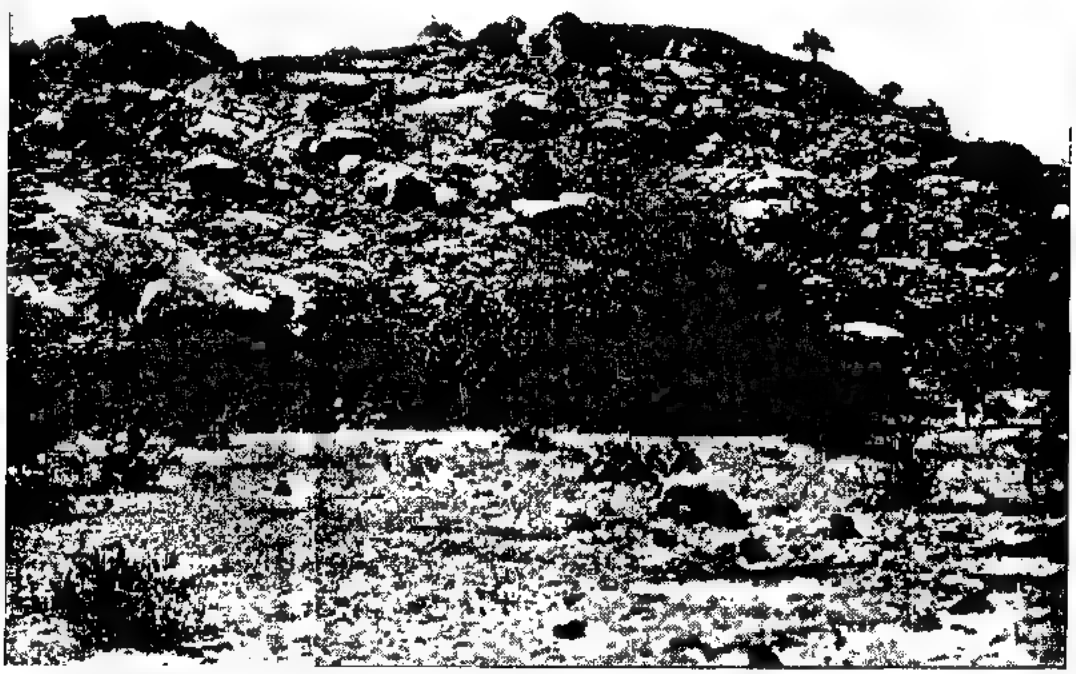


Photo. Mechl. Dept., Thomason College, Roorkee. Photos. by J. S. Battie.

(b). A protected area but open to grazing.

REAFFORESTATION OF DENUDED HILLS IN NORTH ARCOT.

VOLUME XXXV NUMBER 9

INDIAN FORESTER

SEPTEMBER, 1909.

THE PROVINCIAL FOREST SERVICE

There is every indication that the present policy is to gradually expand the Provincial Forest Service in order that the greater part of the executive work of the department may be done by this branch It is, we believe, already laid down that at least twenty per cent of the major charges and all the minor ones in each province are to be held by Provincial officers, and it appears that as opportunity offers the employment of the indigenous agency will be extended as far as possible. We may now be said to be in a transition stage; but already the cadre of the Imperial Service is limited to the number of officers required for eighty per cent of the major charges while few provinces have as yet sufficient Provincial officers, who are experienced enough, to man twenty per cent of the major charges and all the minor ones Our shorthandedness is therefore at the present most marked, and the present sanctioned scales of the Imperial and Provincial Services together are not sufficient for the increasing work of the department It seems evident that if the cadre of the Imperial Service is to be limited to the number of officers required for eighty per cent of

the major charges, a large increase must be made in the cadre of the Provincial Service.

Under the present rules for direct recruitment to the Provincial Service it takes three years for the candidate to pass through his course of training at the Imperial Forest College. After passing he is appointed Extra Assistant Conservator, but has for a further period of three years to be on probation. We may, we think, safely say that it is most advisable that he should put in at least another two years as assistant under an experienced Divisional Forest Officer before he is allowed to take charge of even a small division. If this be admitted, it means that it will take eight years from the time that the candidate enters the College before he is qualified to hold even a small division. We have already stated that, fixed as the Imperial cadre is, by a rigid formula, a substantial increase is absolutely necessary in the Provincial Service Supposing that the necessary substantial increase was sanctioned at once, it will take eight years to train the first recruits for the position of Divisional Forest Officer in a minor charge, and we may safely estimate that it would take from ten to twelve years before the Provincial Service was brought up to the required strength with an adequate proportion of the officers fit for divisional charges. This being so, it seems to us that in the meanwhile it would be very advantageous *if the rule fixing the number of* officers on the Imperial cadre were relaxed until the Provincial Service were brought up to the strength necessary to manage the charges, which it is intended they should do, and any extra number of Imperial Officers could then be gradually absorbed by reducing the recruitment. We, therefore, strongly advocate that for the next ten years the cadre of the Imperial Service be increased to that necessary for the management of *all* major charges and that during that period the Provincial Service be gradually increased, so that after that period the Imperial cadre could be gradually reduced to that now sanctioned, *i.e.*, to a number sufficient for the management of eighty per cent of the major charges.

The new rules for direct recruitment for the Provincial Forest Service are by no means an unmixed blessing, and they have

undoubtedly caused a great deal of discontent among the existing staff of Rangers, who entered the department before these rules came into force. When these Rangers entered the department they had prospects of rising to the Provincial Service ranks if they worked well, whereas they now find that the direct appointments absorb most of the vacancies in that service. In this way the promotion of the better Rangers is retarded, and the promotion also of all Rangers is adversely affected, because the promotion of any Ranger to the rank of Extra Assistant Conservator creates vacancies in each grade of Ranger. Then, again, the rule under which any Ranger can now be deputed to the Imperial Forest College for the third-year course acts often in a most unfair way. In one circle a promising Ranger, who may be quite junior, is deputed for the third year course at the College and on passing out he immediately jumps over all the Rangers in the province and becomes a probationary Extra Assistant Conservator This sort of thing is most galling to the Rangers passed over, many of whom may be quite as good, and some perhaps better, than the one who has thus been specially favoured Let us imagine what an outcry there would be if such rules were applied to the Imperial Forest Service, if by merely going through a special course (without all officers being given an opportunity of going through the course) a junior man could at once qualify for promotion to the Conservator grade and pass over the heads of all his seniors

It may be argued that the object of the new rules is to obtain a better class of officer for the Provincial Service, and this is undoubtedly a wise policy, but surely this should not prevent us from being fair to those already in the service by arranging that their prospects shall not be adversely affected by new rules.

We have already stated that it is necessary to increase the cadre of the Provincial Service. If this is done vacancies in that service may be divided into two kinds, first, those due to the additional posts sanctioned, and secondly, those due to casualties in the posts which existed at the time the direct recruitment rules were brought into force Now the Rangers who were in the service at that time can have no claim to the vacancies of the

first kind, and we advocate therefore that new posts created after the direct recruitment rules came into force be reserved for direct recruitment or for Rangers who may be permitted to undergo the third-year course at the College. We advocate also that all vacancies of the second kind be reserved for the promotion of the Rangers who were in the service before the direct recruitment rules came into force, until such time as all suitable men have been promoted, after which all recruitment would be direct. There are only a definite number of Rangers whose expectations have been adversely affected by the rules, for those Rangers who were appointed after the rules came into force knew, when they accepted appointments, that they could not ordinarily rise to the Provincial Service, unless they passed through the third year course at the College. In our opinion the Rangers in each province who entered the service before the direct recruitment rules issued, should be classified into four classes as follows :—

(*a*) Those who are now fit for promotion to Extra Assistant Conservator when vacancies occur.

(*b*) Those who are considered would be fit if they undergo the third-year course.

(*c*) Those who are under observation ; and

(*d*) Those who will never be fit for promotion to Extra Assistant Conservator.

We think then that definite rules should be framed to safeguard the interests of these Rangers on the following lines :—

Rangers in class (*a*) shall be promoted to the Provincial Service in order of seniority as vacancies of the second kind mentioned above occur.

Rangers in class (*b*) shall be allowed to undergo the third-year course as opportunity offers ; they shall be deputed to the College for this purpose in order of their seniority and as long as there are any Rangers remaining in class (*a*) they shall be appointed to vacancies of the first kind, so that the promotion of Rangers in class (*a*) shall not be retarded.

In this way the claims of all the Rangers whose promotion has been adversely affected by the rules would be considered, and

their prospects would be the same as they were before the rules under reference came into force. The Ranger class, after all, is the one which bears the brunt of the work in the department, and it is most imperative that they should not be made discontented and discouraged by unfair treatment. We hope, therefore, that their case in this respect will be considered and that rules to safeguard their prospects will be drawn up.

Until new posts in the Provincial Service are sanctioned, we advocate that all officers appointed direct to that service, including those who are appointed from among junior Rangers who have undergone the third year course, be given supernumerary posts.

As to the prospects of the Provincial Service, we have heard for years of a coming reorganization, and it is very disheartening for the members of that service that nothing has been announced regarding it. We earnestly hope that Government will be pleased to announce what is being done in this direction, for suspense and deferred hopes are at present sapping the vigour of the whole Provincial Service.

SCIENTIFIC PAPERS.

THE DISTRIBUTION AND CULTIVATION OF *ACACIA ARABICA* (BABUL) IN BERAR.*

BY SHRINIVASALU NAYADU, EXTRA ASSISTANT CONSERVATOR OF FORESTS, BULDANA DIVISION, BERAR CIRCLE.

Introduction

Acacia Arabica is a widely distributed and valuable tree in India. In many parts of the country, as in the plains of Berar, it forms the chief forest crop, and consequently an intimate knowledge of the peculiar features of its sylviculture is of more than local interest.

Disappointments in the raising of Babul crops have been frequently met with, and these have indicated the necessity for considerably modifying the acknowledged principles of protection,

* This paper was read at the Central Provinces Forest Conference in November 1908

maintenance and treatment of forest crops, in a manner suitable for the special requirements of the tree.

With a view, therefore to invite discussion on such special features the following paper was written

General description of the tract.

Berar consists of the four districts of Amraoti, Yeotmal, Akola and Buldana. Each of these, except Amraoti, constitutes a Forest Division of the same name. The Amraoti District contains two Divisions—the Melghat Division and the Amraoti Division. There are three main natural divisions of Berar, *viz.*, the Gawilgarh hills (the Melghat) on the north, the Ajanta hill range (the Balaghat) on the south, and a broad valley (Payanghat) between the above two ranges. These three tracts comprise roughly 1,631, 7,859, and 8,220 square miles respectively. The Melghat Division embraces the Gawilgarh hills The Amraoti Division lies in the Payanghat portion with the exception of a few small tracts presenting the same characteristics as the Balaghat. More than four fifths of the Yeotmal Division is in the Balaghat, only the Wardha and Bembla valleys coming in the Payanghat portion. The Akola and Buldana divisions consist of Balaghat and Payanghat in about equal proportions.

Underlying rock and soil

Generally speaking, the underlying rock throughout consists of the Deccan trap with a variable depth of black cotton soil on the top. In river valleys and on the sides of streams, deposits of silt are frequent. In the Payanghat there is a deep deposit of alluvium, often extending to a depth of 150 feet. Black cotton soil in this plain occurs always at the surface with yellowish calcareous loam underneath. Very often this layer appears at the surface, and it is then not as favourable to tree growth as when black cotton soil is uppermost. The alluvium especially in the heart of the Payanghat, *viz*, along the Purna, contains a good deal of soda salts

Position of Berar as to rainfall and humidity.

The whole of Berar comes within the dry zone described in Sir Dietrich Brandis' pamphlet "The Distribution of Forests in India" This zone has a rainfall varying from 15 to 60

inches and is eminently suited for Babul. In Berar the rainfall varies from 30 in the Payanghat to 58 inches in the Gawilgarh hills, the Balaghat getting an average of 38 inches, and is therefore not excessive for Babul, nor does the humidity of the atmosphere continue beyond the rainy season. The chief factors that influence the distribution of Babul are the situation, the soil and the altitude

Situation and altitude

The Gawilgarh hills average a height of 3,400 feet with steep slopes and contain shallow soil with a substratum of trap rock. In the ravines and valleys of these hills, though deeper soil, may be found a waterless substratum and frosts which are prejudicial to Babul. Thus this portion of Berar is entirely unsuited for the growth of Babul

The Balaghat contains extensive undulating plateaux which vary in height from 1,588 feet to 2,190 feet. Babul exists here as a scattered tree or in small groups on banks of streams, in lands set apart for public purposes close to village sites or amidst cultivation, wherever the soil is deep enough to retain moisture or the water-holding substratum is close to the surface and there is sufficient immunity from frosts and weed-growth. Babul here is fairly common, as it is difficult to pass any considerable stretch of country without encountering a Babul tree.

The Payanghat however contains practically nothing but Babul.

Here the water-bearing stratum is very deep, but the surface alluvium holds sufficient moisture, and frosts are practically unknown. Moreover, the existence of soda salts, to a large extent in the soil, favours the growth of Babul and its few associates to the exclusion of other trees

Thus while it is possible to grow Babul woods in many places in the Balaghat, the Payanghat is best suited for raising Babul crops and most of the State "Babul bans" therefore exist here.

The State Babul forests at present are as follows:

			Acres.
Amraoti Division	...	..	7,068
Akola "	...	...	4,067
Buldana "	...	...	3,467
Yeotmal "	(approximately)	...	1,000
	Total	...	15,602

The great demand for land for cultivation in the black soil country has naturally limited the formation of State Babul bans. For this reason and in view of the great value and importance of the tree to agriculturists, it behoves us to attempt Babul cultivation wherever favourable conditions occur.

Land set apart for public purposes such as gotan (cattle stand), khalwadi (threshing floor), etc., commonly contain a considerable amount of Babul growth. Indeed in the Balaghat tract it is generally these lands that contain Babul when the country around has little or none. These lands therefore form an important source of supply, though owing to excessive grazing and browsing that must take place in them, they do not admit of their being worked with anything more intensive than physical exploitability.

By a rough computation the area of such land capable of growing Babul is probably about 12,500 acres.

It is impossible to gauge the area of occupied lands under Babul outside the State forests. It does not pay the cultivators to set apart land specially for growing Babul. Hence the Babul in private lands is found on boundary strips and nala banks which cannot be brought under cultivation. It is probable that these strips amount at present to at least as large an area as the State forests.

Of the State areas, Bhongaon and Loni forests form compact blocks of 2,014 and 1,047 acres, respectively, in the Buldana and Akola Divisions, and these blocks are under a sanctioned working plan. The remaining areas are scattered blocks consisting frequently of single survey numbers (fields).

Babul bans exist in the vicinity of the Purna in the Buldana Division and the Akot Taluq of the Akola Division. In other places, *viz.*, in the Amraoti Division and the Murtizapur Taluq of the Akola Division the blocks are scattered in the interior.

Varieties. There are three distinct varieties of Babul: Telia, Kaora and Ramkati.

The name Telia is used to imply smoothness, from the notable paucity and insignificance of its spines as compared with those of the Kaora. The fact of its wood being more close-grained than

either Kaora or Ramkati has also given rise to the name. It has a loftier and sparser crown than Kaora, and its pod is moniliform while that of Kaora has little or no constrictions between the seeds. The bark of the Telia is less deeply cracked than that of Kaora.

Kaora means in Marathi "Mad" The abundance of conspicuously stout spines on this tree and its massive crown, seem to have given rise to the above name.

Ramkati develops a straight and tall trunk with cupressiform branches. These branches being always thin, the trunk is pre-eminently conspicuous On account of this the tree is known as Rama's "Kati" (wand). This mythological interest has given rise to a prejudice against the use of this tree for building and other purposes by the Hindus, who even refuse to fell the tree. They are, however, not above selling the tree for fuel, in return for a consideration, provided the purchaser fells and removes the tree himself.

The superstition is also not strong enough to secure the tree against wholesale lopping, and which the cultivators resort to in autumn to diminish perching room for birds that feed on ears of corn. The wounds caused by this practice become the seat of fungi and probably make the axillary buds to develop into cupressiform rather than horizontal branches. This, coupled with the fact that Ramkati is found only on cultivated land, has led some observers to believe that it is only an abnormality.

In and around cultivation in Rajputana, Ramkati is even more common. Thus, there is no doubt that Ramkati has come to exist as a distinct variety. In Rajputana the wood of Ramkati is largely used in house construction, even in cases where ornamental carving is required. In Berar, with the advance of knowledge a greater use will certainly be made of this tree than heretofore.

Of all these three varieties Ramkati seems to need the greatest amount of cultivation of the soil, and as a forest crop it may therefore be neglected. Telia is the more exacting of the two remaining varieties as to quality and depth of soil and moisture. It has also an aversion to localities where the soda efforescence is very

large. Thus it is that Telia exists and grows best close to streams while Kaora can thrive further away.

The scattered situation away from the Purna of the Babul bans in the Amraoti Division and in the Murtizapur Taluq of the Akola Division favours this selection, and in consequence more Telia is found there than Kaora.

Associates.

Speaking of the species as a whole, the number of its associates, owing to its great light loving nature, is very limited. For this reason it does not even admit of our growing a mixture of age classes in a Babul crop. Where it exists as a scattered tree it will generally be found that this condition is satisfied, and when that is so, it grows with any species.

Where it grows pure or nearly pure, especially in the Payanghat, the following are its usual associates :—

Murmati ...	...	...	*Acacia eburnea.*
Hingan ...	...	...	*Balanites Roxburghii.*
Yelatri ..	.	...	*Dichrostachys cinerea.*
Hiwar ...	...	..	*Acacia leucophlœa.*
Soundar ...	..	...	*Prosopis spicigera.*
Pachran ..	...	...	*Capparis grandis.*
Ber .	...	...	*Zizyphus vulgaris.*
Shindi ...	...	...	*Phœnix sylvestris.*
Nim ...	...	...	*Melia Azadirachta.*

In a favourable locality the existence of these associates is not noticeable, but in unfavourable localities the associates become prominent. In areas where the yellow calcareous loam appears at the surface, Babul confines itself to the depressions on account of the deposits of silt or black soil and any or all of the associates save Shindi occupy the rising ground. Similarly, in swampy localities Shindi predominates.

Seasons when new leaves, flowers and fruit appear

Babul is never completely leafless, though in April and May it has very meagre foliage. It brings forth new leaves early in June. It maintains its vegetative activity longer than many other species. It flowers

from July onwards throughout the rains, towards the end of which, about September, the fruit begins to develop. The pods are ripe by February and begin falling to the ground without dehiscing on the tree.

Germination and early life

Babul seed has a hard testa and consequently its germination without some preparation is not always satisfactory. Much moisture in the soil is required to decompose the testa. The seed has been found to remain uninjured in the soil for fully three years, and to germinate well in the fourth monsoon, when a fire had passed over the area sown during the preceding hot weather (Kodad forests in the Akola Division). Long breaks in the rain before germination is complete are also likely to destroy the faculty of germination in the seed. In the Loni-Bhongaon Working Plan, therefore, sowing only when the monsoon has fairly burst is prescribed.

From all the above it is evident that some method of forcing germination is necessary.

The cheapest and the best method is to feed cattle, especially goats and sheep, on the pods and obtain the seed that has passed through them. Such seeds are less subject to attacks by weevils when they are stored.

The seedling develops a strong and fairly long tap root and gives rise to numerous lateral roots even at the end of the first season. As the growth advances the difference between the tap root and lateral roots as to strength, size and importance is lost. The root system therefore becomes compact and massive. For this reason the species requires the water-bearing stratum fairly close to the surface or soil sufficiently deep and hygroscopic to yield the required moisture.

It is popularly believed that Babul growth dries up streams, and some observers have been of opinion that Babul growth reared in marshy land has converted it into dry land. This belief is, in some cases, the cause of the destruction of the tree on private land. It is, however, remarkable that a large amount of water oozes out of the stumps of freshly felled Babul which is seldom or never found in other trees in Berar.

Above ground the seedling develops spines one month after germinating, which protect the seedling against all kinds of cattle except browsers. It displays its light demanding nature from the very commencement. Thus, when it is hampered by grass and weed growth it remains fragile, but when it is freed by weeding or grazing it grows vigorously developing strong lateral branches and attaining, in favourable localities, a height of about 4 feet in the first year. Though the main stem is always distinguishable. Babul retains a bushy appearance for a long time. For this reason, it is necessary to grow Babul fairly dense to secure good height growth. It does not seem to suffer (Telia more so than Kaora) in spite of its light demanding nature, from the interlacing of the branches or crowns. Generally speaking a Babul crop attains a height from 12 feet to 15 feet in 10 years.

Later life of Babul.

Babul grows rapidly in height, attaining its maximum, which is from 20 to 30 feet, in 15 to 20 years, beyond which period lateral growth only continues in favourable localities even up to and beyond 40 years. Telia when allowed to grow on like this attains a height of even 40 feet.

A radial growth of 5 rings to the inch has been recorded in the Loni-Bhongaon Working Plan. Evidently, the ring countings have been made from more or less average stems. Trees on favourable situation, such as nala banks, have given an average of 2·3 rings to the inch. In exploiting a crop of Babul, however, there seems no use to wait longer than 25 years, but selected trees could be grown to a girth of 6 feet in 35 to 40 years on favourable situations.

Of the three varieties Ramkati grows fastest, next comes Telia, and last of all Kaora. Telia is the longest lived tree of the three.

Reproduction.

Babul produces fertile seed at an early age, individuals hardly seven years old have been found to bear flower and fruit. It is fully fertile from 12 to 15 years. It does not coppice well, though in the early stages of its growth it is able to successfully replace an injured leader

or to shoot up anew when the stem gets cut off altogether. The stools of old trees do not send up shoots at all. Those of trees not exceeding 2 feet in girth, send up shoots but they only develop into bushes.

Uses

The uses to which the Babul tree and its various parts are put to are too numerous to be described in detail in this paper, which must, obviously, confine itself to enumerating only such as influence its sylviculture. It is most useful to the cultivator in all stages of its life In the earlier stages it yields him thorns for fences; when it reaches the sapling or pole stage it yields him poles and posts for his huts *(chappars)*, shafts for ploughs and hoes, wood for the frame work and legs of rough charpoys and so on; at a later stage agricultural implements are made out of it; when mature the wood becomes fit for beams and karies of "dabhas" (flat roofs), door choukats, cart wheels, etc., and lastly the cultivators' cattle feed considerably on the pods.

As a timber Telia is greatly prized because of its wood being close-grained and more durable than either of the other two varieties and when grown, so as to form a canopy, it yields a fairly straight clean bole, 15 feet to 20 feet long. Such specimens may be met with in favourable localities of State Babul bans, in road side strips, khalwaris, and so on. Telia seasons well, and storing the wood for one year is considered to season it sufficiently for ordinary use.

Kaora is, as a matter of necessity, used as timber in place of Telia where this is not available. Its wood is coarse and brittle and seasons badly, cracking a good deal during the process. These defects do not come in the way of its being used for agricultural implements. The prejudice against the use of Ramkati as timber has already been described.

All the three varieties yield very valuable fuel, next only to coal. Babul fuel gives rise to deposits of salts on the inside of boilers, but this it does to a much smaller extent than other kinds of firewood. This drawback, however, is overlooked as the price compares favourably with coal. Hence there is a good demand

for Babul wood for the ginning factories and cotton presses which exist in numbers in many parts of the country, the contractor getting 8 to 10 rupees a ton according to the character of the cotton season, while his cost including what he pays to Government, varies from 6 to 7 rupees a ton. The price of coal varies from Rs. 12 to Rs. 16 a ton. Branchwood, too thin for engine fuel, is cut up into billets about 2 feet long and sold to factories for lighting engines and as *chula* fuel in the larger towns. The price obtained for this small wood is Rs. 15 and more per ton.

The bark of the tree yields a strongly astringent decoction and is used largely in native medicines. It is also used for tanning purposes.

The gum is said to be strengthening ; it is fried, made up with sugar into a sweetmeat, and given to convalescents.

Cattle feed on the pods, and they are largely used for tanning purposes.

Injuries to which the tree is liable.

Babul is subject to injuries from the very commencement of its life. A young Babul crop growing with the branches interlaced, affords an ideal cover for rats, hares and deer when the country all round is bare The deep cracks in the black cotton soil is specially favourable for rats, as was noticed in Bhongaon last year where the antelope rat (a species of *Tatera**), which lives in deep burrows, did a lot of damage to young Babul.

Rats gnaw the bark of the seedlings or cut of the shoots or devour the roots ; hares cut off the shoots often down to the ground; deer browse the shoots. The injury begins when the seedlings are weeded in the rains, but becomes very noticeable as the harvest is over and there is nothing succulent or green in the fields to invite them. Fortunately, except where the root is destroyed, the seedling usually recovers though it may lose one or two years' growth.

Rats, which are the most injurious of the above three animals, do not multiply to an alarming extent every year or appear in large numbers in all Babul bans, as their existence largely depends on the character of the monsoon, heavy rain, however

* Surely this must be *Gerbillus indicus*.—HON. ED.

fitful it may be, being injurious to them. It has just been found that the antelope rat rears its young in nests built some 2 feet above ground in the interlaced branches of Babul thickets. This knowledge is of considerable help in keeping down their numbers.

Ratin and other preparations which are said to create an infectious disease among rats have not yet been tried.

Full grown insects of *Batocera*, *Psiloptera* and *Cantharis* beetles eat the leaves and the bark of the branches and twigs of young plants. This not only diminishes the vigour of the individuals but also seriously retards their upward growth. When the stems attain a diameter of about 1½ inch, a more serious injury comes to notice. The larvæ of the *Batocera* beetle tunnel through the wood. These tunnels are about half an inch in diameter and frequently two such tunnels are found in one stem. The larvæ attack the stem at ground level and tunnel both ways but largely upwards keeping open an air-hole through which are cast fibrous masses of wood tissue that has passed through the grub. This excreta accumulates in masses several inches high on the ground close to the stem, and betray the existence and activity of the enemy inside. The larvæ is found to be at work for quite seven months—December to the middle of July—when it pupates. Thus the damage, remembering the diameter of the stem attacked, is severe in spite of the extraordinary vegetative activity of the tree.

Observations regarding the life history of these beetles are being made, and a beginning has been made this year to capture and kill the full-grown insects which fly about singly and are easily caught. Among domestic animals, goats alone do serious injury, other animals do practically no harm, unless the number of cattle allowed to graze in the crop is very large and grazing is allowed too soon after germination. Light grazing, as will be described later on, affords distinct advantages.

For thorns and fencing the saplings are hacked and the large trees lopped ; for minor agricultural and household requirements reckless lopping is resorted to, for bark the tree is nearly girdled and for fodder the pods are beaten down with long sticks. Luckily,

making gashes in the trunk to promote the exudation of gum is not practised.

Babul has a wonderful capacity for healing up wounds. Seedlings grown up on mounds have been found to fuse together into a single stem looking like coppice shoots grown on one stool, but withal the tree does not fully recover from the injuries it receives in its earlier life, and falls a victim to the ravages of fungi when it is nearing maturity.

Fomes pappianus is the fungus that does most damage to Babul in Berar. The sapwood remains uninjured by its attack and the tree, therefore, maintains an outwardly healthy appearance. The heartwood, however, is rendered more and more brittle as the fungus gains ground, till the tree is no longer able to withstand the force of ordinary wind and is blown down. In a badly attacked tree the wood crumbles to pieces like broken tiles. The Kaora and Ramkati varieties suffer more from the attack than Telia, because the wood in their case is not as compact, and Kaora with its massive crown more easily gives way to the action of wind.

This fungus is known during the last two decades to attack Babul, but its ravages were discovered to have attained serious dimensions in 1902-03 in Loni and Bhongaon reserves, where large stretches of forests were seriously affected. With a view to utilize such badly attacked portions before the rest, the order of felling in the Loni Bhongaon Working Plan was changed for seven years—1903-04 to 1909 10. The prohibition in the Working Plan to do thinnings was observed to have rendered the crop in many places congested and languid. Thinnings were, therefore, at once taken in hand and the whole area was gone over in 1902-03 and 1903-04. During the progress of this operation most of the diseased trees, as a matter of course, were removed and the sporophores were systematically removed and burnt. These operations have now considerably reduced the seriousness of the pest.

The origin and propagation of this fungus is not yet definitely known. It is not certain whether it spreads by means of mycelia in the ground or through wounds and defects in the trees. It

attacks isolated trees, and trees in the midst of cultivation just as much as it does trees growing in a canopy with soil round about untouched. The remedial measures, therefore, were conducted on general lines calculated to purify the soil after felling, to increase the vigour of the trees and to retard the dissemination of the spores by removing and destroying the sporophores. It is noteworthy that young and vigorous Babul is not attacked. Nearly all the trees attacked are those that have ceased to grow and have commenced to contract their crowns, be this the outcome of old age or of injuries.

Regeneration.

It has already been said that Babul does not lend itself to be grown as a crop of mixed ages. It is also characteristic of the tree that young growth does not come up when the old trees are standing on an area in any numbers. Hence we have always to be prepared to re-stock a blank area.

On boundary strips and nala banks in the midst of cultivation, trees could only exist scattered. There, therefore, old trees could stand when younger ones equally scattered are preparing to replace them These strips afford ideal conditions for the natural regeneration of Babul Cattle, including goats and sheep, permitted to roam about wherever they please after the crops are harvested, bring in the seed by means of their droppings, as they feed on Babul pods, and this supply is supplemented by floods on nala banks.

The cattle devour all the available grass, trample and triturate other weeds and tear up the ground with their feet, so that the seed is at once brought into contact with the mineral soil. The seed, as it has passed through cattle or has thoroughly soaked in the flood water, easily germinates in the rains At the same time the fields get sown up for agricultural crops and the general roaming about of the cattle is stopped.

The plough bullocks and milch cattle of the cultivator however, are led in the fields and pastured on the strips. This limits the amount of grazing and serves to put down weed growth to an extent favourable for the healthy progress of Babul seedlings,

and for reducing to a minimum the cover for rats and hares, since what is not eaten by the animals is trampled down by them. To the Babul seedling itself little or no damage is done, thanks to its spines and its recuperative powers. This process is repeated year after year with the result that very often the cultivator considers Babul a nuisance, in spite of the rough treatment he gives to the growth as already described and in spite of some amount of goat grazing that cannot be avoided.

In Government waste lands other than State forests (khalwaris, free grazing lands, gothans, etc.) where time is no consideration, Babul growth has originated in the above manner.

In State forests successful re-stocking as soon after the felling as possible, is of great importance. Trusting, therefore, to nature alone to do the re-stocking is not sufficient in these areas. Hence recourse must be had to one or more of the methods of artificial regeneration.

In the Loni-Bhongaon Working Plan, broadcast sowings are prescribed on ground more or less prepared, by means of the felling and export operations, to receive the seed, with subsequent closure to grazing for three years. It is also prescribed that should the first sowings fail, the ground should be ploughed up (probably strip sowings were intended) and sowings renewed the second year and thereafter till success is assured, the period of closure to grazing being extended accordingly.

Systematic exploitation of the Bhongaon Babul forests was commenced in the year 1895-96 and the prescriptions of the Working Plan duly carried out, but expectations as to re-stocking the exploited areas were not sufficiently realised, for out of a total of 497 acres felled from 1895-96 to 1902-03, only 135 acres flanking the "Mass" nadi became fully stocked. The balance, the major portion of which lies away from the "Mass," had to be leased out for being sown under the agri-sylvicultural method. This state of affairs could have been averted had grazing of non-browsers been permitted to the extent to which it obtains on the uncultivated strips in the midst of fields, as already described, but this unfortunately was not allowed.

The policy followed elsewhere was also similar. For instance, in the Murtizapur Taluq, 390 acres of Babul forests were exploited in the eighties. Broadcast sowings were made in these areas and grazing prohibited. Partly with the object of diminishing the risk of fires and partly on financial considerations the areas were, however, annually leased for grass cutting. The result of this was that even the few seedlings that came up and struggled were cut away along with grass. When this error was discovered, grass cutting was at once stopped, and systematic re-stocking operations were taken in hand, the salient feature of which was the admission of light grazing. Generally speaking no grazing was allowed during the monsoon in which the sowings were made, but from October onwards cattle, up to two head per acre, were allowed to be pastured on the areas. Goats and sheep of course were rigidly kept out. Owing to this change in the policy, the area noted above with the subsequent additions is now fully stocked with most promising growth.

Two photographs* are put up to illustrate these results.—

(I) Represents the result of strip sowings in Nawsala forests, Survey No. 68, the area which was completely bare was sown up in 1893 rains, and failures renewed every year up to 1897 rains. The crop is now over 20 feet high and thinnings were made for the first time last year.

(II) Represents the result of mound sowings in Kodad forests, Survey No. 89; the area which was dotted with young bushes was sown in 1892 rains, and failures renewed in the 1893 rains. The crop is over 20 feet high and thinnings were made for the first time in 1904-05 and 1905-06.

If advantage is not taken of grazing to put down weed growth, it becomes necessary to weed round, for one or more years, the seedlings that do not stand higher than grass and weeds. This is a slow and expensive work and can never be free from risk of fires. The labourers have to be paid higher wages than they get from

* [We have not received copies of these photographs, but if the author will kindly send them to us we will publish them in a future number.—HON. ED.]

agriculturists, as freeing thorny bushes from weeds is not very inviting work when employment is plentiful in fields all round the village.

In the Bhongaon forests weeding has been resorted to, to give the seedlings that have come up successfully as a result of the agri-sylviculture sowings the light that they require. The cost has been on an average Rs. 2 per acre per annum, and the operation will probably have to be continued for three seasons, at the end of which grazing will probably be allowed. This expenditure of Rs. 6 an acre would have been avoided had light grazing been permitted.

When by either of the above described means sufficient freedom from weed growth is ensured for the seedlings, the following methods have given satisfactory results :—

(I) *Broadcast sowings.*—This succeeds on areas which flank small streams that flow from Babul woods through the area to be sown up. The cost should be trifling, about 4 annas an acre.

(II) *Mound sowings.* These are made in areas subject to floods or in swampy or water-logged situations. Low mounds 6 inches high and 2 feet in diameter in lines 8' × 4' have given good results. The cost has not exceeded Rs. 3 an acre.

(III) *Patch sowings.*—These are made in sowing up open places amidst young Babul growth or of other species that may be already existing where the plough cannot be worked. Patches 2' × 1' cleaned to a depth of 6 inches in lines 8' × 4' have given good results. The cost should not exceed Rs. 2-8-0 per acre.

(IV) *Strip sowings.*—This method is the one that has been largely adopted up to date. The strips are made at intervals of 10 feet by means of three confluent plough furrows ; each strip would therefore be about 2½' broad. The cost has been from Rs. 2-8-0 to Rs. 2-12-0 an acre.

In the above four methods, parking goats and sheep all over the area before the first sowings are made, is recommended if possible.

Where germination is not complete those patches or mounds or lengths of strips that are blank should be raked up and re-sown in the following rains; 4 annas an acre was found sufficient for this.

(V) *The agri-sylvicultural method.* This method is of recent origin. It consists of raising any field crops for the first two years over the area to be sown, and of sowing Babul in the third year along with cotton, three lines of cotton being put in between any two consecutive lines of Babul. The latter therefore gets a spacing of 7 feet. The Babul lines are weeded as thoroughly and as often as cotton.

This is the surest method of getting up regeneration, and one that gives a good start to the seedlings, minimizes the advent and multiplication of insects and fungi, in spite of the fact that the cotton crops often attract rats. As the coupes are sold with permission to cultivate the land for three years, the prices paid in some localities to Government have increased by about 100 per cent. The advantages, therefore, more than counteract the loss of two years' growth after the felling. On favourable situations, the Babul lines meet laterally in two seasons, the height of the first year being 4 feet Elsewhere, the lines would require three to four years to meet It not infrequently happens owing to variations in soil or situations or other accidental causes the lines are not full, or in average situations the intervals between the lines cannot be covered over in two seasons It is then advantageous to allow, wherever possible, cotton cultivation for another year on the condition that only two rows of cotton are raised between each pair of Babul lines, that the latter are not disturbed during the preparation of the soil for cotton sowings, that blank lengths in the Babul lines are raked up and re-sown and that the Babul lines are weeded. This plan materially checks weed growth and lessens the risk of fires.

Cultivators, however, are not very willing to take up this fourth year cultivation, as working the hoe between the Babul lines is a tedious process. The thorny branches striking against their legs, the bullocks refuse to work.

In any case as only selected areas could be treated in this manner, the leases for this mode of cultivation are given out for three years only.

The operation costs Government in the beginning nothing beyond supervision and perhaps assistance to collect the right kind, quality and quantity of the seed. The collection of seed is a difficult business, as the sowing is made in drills and so much as 15 seers to the acre is needed for the first sowing. For renewing of failures three seers per acre would be sufficient.

When the three-year lease has expired a reward of not exceeding Rs. 2 an acre is paid on account of fully stocked areas. This is an incentive to good work.

Reducing the period of the lease to less than three seasons would not pay the lessees, as the cost of first preparing the soil is large (about 8 rupees an acre) and the crop in the first year is not reliable as the soil will not have undergone sufficient ærating.

It is obvious that this method has its "raison d'etre" in localities where there is a demand for land for cultivation. Such demand exists in many parts of the Payanghat and the system is therefore coming into favour. In the Buldana Division alone the following areas have been satisfactorily treated under the above method :—

Bhongaon reserve	...	..	576 acres.
Other Babul bans	...	...	197 „

Photograph III represents successful agri-sylvicultural sowings on an average area in Bhongaon coupe No. 7. The growth is three seasons old and the lines nearly closing laterally—note the weeding party is nearly hidden.

Photograph IV represents agri-sylvicultural sowings two seasons old, two rows of cotton having been permitted to be grown between the Babul lines as these were found to be insufficiently stocked at the end of the first season.

Treatment.

The following extracts from the sanctioned Working Plan of the Loni-Bhongaon Reserve and the proposed Working Plan for the forests of the Amraoti Division, give the opinion of Berar forest officers on the treatment of Babul woods in 1902 :—

LONI-BHONGAON PLAN.

"A careful examination of the Babul growth in the Purna valley has shown that the tree begins to deteriorate and branches die off after the tree has attained a diameter of nine inches, while fuel of that size is also most saleable.

"From the results of ring counting on 44 stumps in Loni, it has been found that the average annual radial growth is 19 inches, or, say, five rings per inch of radius, and this tends to show that the Purna Babul takes about 25 years to attain a girth of 30 inches.

"The figures given above might justify the adoption of 25 years as the period taken to attain maturity, but it is hoped better management as to protection, etc., will render it possible to lengthen the healthy life of the tree, while it is also well to allow a margin for safety as to complete reproduction, so that 30 years has been adopted as the rotation for the first period, which, owing to the existence of blanks and the irregular distribution of age classes, must be looked on as partly reconstructive, partly transitional. The fact that we are trying to introduce the longer lived Telia in lieu of Kaora, a short-lived tree, is another argument in favour of adopting 30 years for re-stocking the forest."

PROPOSED AMRAOTI PLAN.

"The object to be striven for here is the largest possible yield, since fuel is the main produce required and along with the fuel there will always be obtained a certain proportion of timber. Accordingly, a long rotation is to be avoided. We have no exact data for determining the best rotation to adopt, but the consensus of all Berar forest officers favours a period of 25 years, by which time Babul grown in canopied crops will have attained its maximum height, and the individual stem will be from 2 to 4 feet in girth. If larger timber is required, a few select stems can be spared at the time of exploitation along the border of the coupe to grow on for another rotation."

Experience has shown that an allowance of three years must be made to successfully re-stock areas. This would weigh in favour of the adoption of a 30-year rotation, but the ravages of fungi are liable to occur after an age of about 20 years. Thus it

seems best to adopt a rotation of 25 years, reserving in favourable places select specimens of Telia, if available, to grow to large timber, till the end of the next rotation. The number of these reserves should be very limited and the trees should stand very far apart. About four trees to an acre would be the utmost, and there should be no hesitation to confine to this number, as even when the whole crop is allowed to grow on the conspicuously big trees would not exceed that number.

Modified as above, clear fellings would be the method of treatment most suited for Babul. When Babul is grown in suitable localities in mixed forests or round the waterspread of tanks the soil generally does not exceed three feet in depth and the sub-soil is nearly always impermeable. In such cases trees begin to die at an earlier age. A shorter rotation, 20 years, would be advisable in these cases.

Recent experience has shown that one or two periodical thinnings are necessary for the healthy development of Babul. These operations have been carried out to a considerable extent in the Amraoti and Akola Divisions in the interest of the young Babul crop raised during the past decade and a half. In the Murtizapur Taluq alone 391 acres have been thinned during the last three years. These areas represented a growth of 10 to 13 years after the sowings were completed, and as an allowance of two to three years after the felling has to be made for completing the re-stocking operations it is safe to conclude that the first thinning is best made in the fifteenth year after felling. This operation would be moderately severe as the crop does not cease upward growth till some four or five years afterwards, so that the second and severe thinning in the 20th year after the felling would have for its object the promotion of only lateral growth.

Financial aspect of Babul cultivation and conclusion.

Before thinnings in Babul bans were introduced the revenue from Babul crops varied from Rs. 25 to Rs. 60 an acre. As what is lost in the thinnings is likely to be gained in the shape of improved growth by the time the final fellings become due, it seems quite safe to look forward for an average value of Rs. 40 an acre from final fellings.

The thinnings done in the "bans" of the Murtizapur Taluq were first thinnings as already described. Those done in the Bhongaon forests of the Buldana Division were made in the old growth and could be taken to be of the nature of secondary thinnings.

The receipts in both cases were about equal, *viz.*, Rs. 7-3-0 an acre, but as no thinnings had been previously made in Bhongaon it is probable that more than Rs. 5 an acre could not be expected in the second thinning.

These operations having to be done always departmentally, the cost was Rs. 4 an acre in the former (the first thinning) and Rs. 1-8-0 an acre in the latter (secondary thinning) case.

Summing up, therefore, the receipts and expenditure in rearing a Babul crop would be per acre at the end of a rotation—

Receipts.

	Rs.	a.	p.
First thinnings	7	0	0
Second thinnings	5	0	0
Final fellings	40	0	0
Grazing and other sources Re. 1 per acre per annum ..	25	0	0
Total ...	77	0	0

Expenditure.

	Rs.	a.	p.
Initial sowings	3	0	0
Subsequent renewal of failures . .	1	0	0
Cost of first thinning	4	0	0
Cost of second thinning	1	8	0
Miscellaneous charges such as remedying natural injuries, &c., 1 anna per acre per annum ...	2	0	0
Total	11	8	0
Profit .	65	8	0

If grazing is not permitted for the first three years but weeding resorted to, the cost would increase by Rs. 6 per acre—even then the margin of profit is large. The net return to Government would vary from Rs. 2-6-0 to Rs. 2-10-0 per acre per annum, a

rate which compares very favourably with the rate of land assessment in the black soil country and which accords Babul a high place among forest crops. With the greater cultural attention now paid to Babul crops, it is probable the future annual yield of [redacted]

twice or thrice as much as could be obtained from the State forests. Hence it is time that cultivators and others assume a friendly attitude towards the tree. The requirements of the tree, the soil and situation being suitable, are so simple that there should be no difficulty for cultivators to adhere to the rule of felling a tree only when they have grown another on their land to take its place, and for the Forest Department to make plantations wherever the ground in the State forests is suitable.

ORIGINAL ARTICLES.

RE-AFFORESTATION OF DENUDED HILLS IN THE NORTH ARCOT DISTRICT, MADRAS.

The accompanying photographs show the results of afforestation of the Chittoor Reserve, an area which includes small rocky hills and some level ground.

Plate 17.—Photo. A.—This is an unprotected area and a typical example of a denuded hillside in the Deccan and Carnatic Madras. There is absolutely no vegetation remaining—the trees' seen in the foreground of the photograph form part of a road avenue.

Plate 17.—Photo. B.—Is a protected area but it has been continuously open to grazing and the removal of manure leaves.

Plate 18—Photo. C.—Is another protected area. Since 1893 it has been closed to grazing and fellings. From 1893 to 1899 and

(c). A protected area in which Sowing and Planting has been done.

again from 1904 up to date, a good deal of planting and sowing has been done.

Plate 18.—Photo. D.—Shows individual growth of Red Sanders in the protected area shown in photo. C. This tree, *Pterocarpus santilinus*, is the species which has done best It did not exist on this area before planting began.

The small hills shown in first three photographs, lie within a quarter of a mile of each other. It is certain that in 1883 when the areas shown in photographs B. and C. were first placed under protection, the growth on all these hills was similar.

Photograph B. shows that, on an area on which most of the tree-growth has already been destroyed and which remains open to grazing, there is small chance of any improvement. Photograph C. shows what can be produced artificially at no great cost, on an area closed to grazing. This area is 385 acres and the expenditure up to date has been under Rs. 1,500. This does not include cost of permanent establishment. Photo D shows that of the species tried - Red Sanders has succeeded best and is *the tree* to introduce whenever attempts are made to plant up denuded hillsides in the Deccan and Carnatic. The other species tried are *Pterocarpus Marsupium*, *Terminalia tomentosa*, *Anogeissus latifolia*, and teak—but specimens of these are few and far between. From the records it does not appear that any planting was done till 1893—from this year till 1899 the larger trees found in the reserve must have been planted. From 1899 till 1903 practically nothing was done, but there is nothing on record to show why planting was discontinued. In 1904 planting of Red Sanders was again started and it has been continued ever since. All the hilly parts of the reserve are now well covered with saplings and seedlings. From the older trees there is also good natural reproduction The tree thrives best along the ridges in the crannies between rocks where it shows very good growth *vide* photo. D

Red Sanders is found only in the Cuddapah and North Arcot Districts and perhaps in a very small area in Kurnool and Nellore—in range, therefore, there is no important Indian tree of so circumscribed a distribution—the tree has great powers of natural

reproduction and the timber is very valuable being second only to sandal wood.

VELLORE: J. S. BATTIE.
5th July 1909.

FOMES LUCIDUS (LEYS) FR., A SUSPECTED PARASITE.

One of the largest and handsomest of the *Polyporaceæ* or bracket fungi is *Fomes lucidus* (Leys) Fr. It is found in almost every part of the earth except the Arctic regions, but reaches its greatest development in the tropics. There is scarcely one of the larger fungi so variable in size and form. Typically it is stipitate, with a thick stalk (stipe), the surface of which in well developed specimens is hard, brittle and polished. The pileus or bracket is borne laterally in the majority of cases, being then attached by a broad base to the expanded upper portion of the stipe. In shape it may be spathulate, flabelliform, reniform or sub-circular. The thickness of the pileus diminishes from as much as 2 inches near the stipe to ¼ inch near the margin. The latter is blunt and may be entire or lobed. Sometimes the stipe is absent, the whole sporophore being reduced to a stout tubercle bearing the hymenium on the under surface of the overhanging parts. The sporophores may occur singly or in clusters or may be imbricated. The diameter of the sporophores varies from 1 to 10 inches and the stipe may be several inches long and from ½ to 2 inches in diameter. I have seen a specimen in Dehra Dun growing in long grass at the base of a tree, where the plant consisted of an irregularly expanded mass more than a foot in diameter and borne on a number of short tubercular stalks. The stalks are usually fully developed before the pilei begin to form, and as the latter coalesce freely with one another, where they come into contact, these large forms usually consist of several originally distinct sporophores. The tendency of the sporophores to grow together wherever they touch, also leads frequently to the inclusion of weeds and grass and even of bits of stone in the pileus.

The most striking character of the fungus is the formation of a coloured gummy substance on the surface of the stipe and upper

surface of the pileus, which dries into a smooth, hard, thin and shiny varnish, resembling a coating of lac. This varies in colour from the usua reddish chestnut to yellow on the one hand, and almost black on the other. The colour is usually light and the varnish absent towards the margin.

The upper surface of the pileus is usually marked by concentric rings especially towards the margin, and sometimes also by radially arranged lines or tubercles.

The interior of the sporophore is brown and composed of a soft fibrous substance, arranged in radiating bands extending from the stipe into the pileus. Portions in active growth are whitish and of such a consistency that a "thumb impression" can be readily obtained on them.

The hymenophore is inferior, white or whitish and unvarnished. The white layer is quite superficial and consists of the margins of the sporiferous tubes or pores. The tubes are long, deep-brown and less than ¼ mm. in diameter.

The spores are borne on basidia lining the interior of the tubes, four on each basidium. They are ovoid, broader at the base, and covered at the free end by a hyaline cap, which readily collapses leaving the apex truncate. The wall is marked by radiate dark lines, which gives the spore a false appearance of being finely warty when examined with low powers of the microscope. They measure $8{\cdot}5$ to 11μ. by $4{\cdot}8$ to $7{\cdot}5\mu$. in diameter.

The habitat is usually at the base of trees, often also on the lower part of the trunks of dead standing trees, less often in grass and then usually near trees, or on old wood.

The number of species of trees on which or near which *Fomes lucidus* occurs is very large. It includes chiefly broad-leaved trees, but also some conifers (*Abies, Tsuga*, etc.).

Though this striking fungus is common and very widely distributed, there is usually no reference to it in works on tree diseases. It is ordinarily considered to be a saprophyte. I have found, however, two cases mentioned where it is considered to be parasitic. The first is in the disease of mulberry known in Italy as "falchetto" This is usually considered as due to the "honey

Agaric," *Agaricus melleus.* According to Comes,* however, Bertoloni in 1878 held that *Fomes lucidus* was, in part at least, the cause of the disease. A better authenticated case is in a disease of *Cassia siamea* in Java. Raciborski in 1898† showed that this is caused by *Fomes lucidus*, which attacks the tree through wounds. Experiments showed that the mycelium spreads first in the wood parenchyma, and then passes through the medullary rays into the deeper layers. Cellulose and wood-gum are dissolved, and the wood becomes of a yellowish or greyish-white colour Severely affected trees become much weakened and are easily blown down by the wind.

In spite of the usually believed saprophytic nature of the fungus, there is considerable evidence that it is a common, wide spread and destructive tree parasite in India. This evidence is based on the observations of several forest officers as well as my own. It may be summarised briefly as follows.

In the Royal Botanic Gardens, Calcutta, several large *Casuarina* trees have died from the effect of a parasitic attack at the base of the trunk. All the characters of the disease appear to point to a fungus rot which affects the base of the trunk and probably also the large roots. *Fomes lucidus* was found fructifying freely on the rotted wood, even before death of the tree had occurred, and no other wood-destroying fungus could be found in this position. This case I noticed in 1901.

Early in May, 1905, I investigated a very serious disease of the Betel palm (*Areca Catechu*) in Sylhet It was due to a root attack by a fungus, the mycelium of which invaded not only the roots but also the base of the stem. Without laboratory facilities I failed to obtain cultures of the fungus, and hence was unable to carry out inoculation experiments or to determine the identity of the parasite. The dead palms, however, bore commonly on the base of the stem the sporophores of *Fomes lucidus*, and there appeared to be fair presumptive evidence that the parasitic mycelium

* Comes, Dr O Crittogamia Agraria. Naples, 1891, p. 64.

† Raciborski, M. Uber das Absterben der Djowarbäume (*Cassia siamea*) auf Java. Forstlich-naturwissenschaftliche Zeitschrift, Vol VII, Heft 3, 1898.

belonged to this fungus. An account of the disease was published in the Agricultural Journal of India, Vol. I, p. 306, 1906.

Towards the end of the same month I received from Mr E. P. Stebbing, then Forest Entomologist to the Government of India, specimens of a fungus found on the base of the stem of Shisham trees (*Dalbergia Sissoo*) in the Changa Manga Plantation, Punjab, which were dying from what Mr. Stebbing said was undoubtedly a fungus disease. The fungus proved to be *Fomes lucidus.*

On February 15th, 1909, Mr. W. Mayes, Deputy Conservator of Forests, Lahore Division, sent me the same fungus on the same host and from the same locality. He stated "the fungus appears to me to be a true parasite. It appears to attack the living tree at the collar, and rapidly kills it. The sporophores almost always come out at the collar, or on roots which are very close to the surface of the ground."

A short time previously (in November, 1908) Mr. Stebbing sent me a fungus reported to be killing *Dalbergia Sissoo* and *Acacia arabica* on the Sirhind Canal. This also proved to be *Fomes lucidus.*

Mr. Mayes also sent me the same fungus in September, 1905, with a note that it was parasitic on a large old *tun* tree (*Cedrela toona*) in Kangra. The sporophores were growing on the trunk about a foot above the ground.

Finally, I may mention that a large mulberry tree in my compound at Dehra Dun was attacked by a rot at the ground level, and here again sporophores of *Fomes lucidus* were observed to appear in two successive years.

All these instances appear to constitute a strong *primâ facie* case against the fungus. If it is really a parasite then it must be ranked as one of the most destructive tree parasites in India The number of its hosts is large, and as those already cited belong to so many different orders, it is not likely that they exhaust the list of trees injuriously affected by it. Definite scientific proof is, however, required. This would necessitate getting the fungus into pure culture, and carrying out a series of inoculations with the cultures by inserting portions of them into wounds at or below the

ground level of healthy trees of the species selected. Probably the most convenient method of obtaining pure cultures would be to cut out aseptically (by means of a flamed knife, which may be used nearly red hot if the cuts are made quickly) a small block of mycelium from the sporophore. The block should be quickly transferred to a sterile tube with a little water in the bottom. A flocculent mycelial growth may be expected to result from the surface of the block, and a little of this, picked up on a flamed needle, may be used to inoculate fresh tubes containing some nutrient material, such as a sterilised piece of *Shisham* wood. The actual tree inoculations should present no difficulty, the chief requirements being to select hosts of a suitable age, to inoculate at several different places and at different depths and to keep the inoculated wound moist by wet bandages for a few days to allow of penetration.

PUSA: E. J. BUTLER.

March 4th, 1909.

DESCRIPTION OF THE PLATE (PLATE 19).

1. A sporophore of *Fomes lucidus*, viewed from above and behind. Specimen from rotting wood, Pusa. About ⅔ natural size.

2. Section through the same.

3. A small spathulate sporophore, viewed from the side to show the white poriferous surface below. Specimen from rotting wood, Pusa. Natural size.

4. Spores of *Fomes lucidus*. × 1300.

THE ANNUAL CONFERENCE OF THE PHILIPPINE FOREST SERVICE.

BY ROYAL FREEMAN NASH.

The Philippine Forest Service held its Fourth Annual Conference in Manilla from June 7th—12th, 1909, meeting each morning from nine to twelve in the office of the Director of Forestry, Major George P. Ahern.

THE PROGRAMME.

Monday, June 7th.

ADDRESS OF THE DIRECTOR OF FORESTRY.—Major George P. Ahern, 9th U. S. Infantry.

REPORT OF THE CHIEF CLERK.—Amos G. Bellis.

REPORT OF THE CHIEF OF THE DIVISION OF ADMINISTRATION.—William Klemme, Forester.

REPORT OF THE CHIEF OF THE DIVISION OF INVESTIGATION.—Harry N. Whitford, Ph.D.

Tuesday, June 8th

REPORT OF THE CHIEFS OF ADMINISTRATIVE DISTRICTS.—William Klemme, Forester in Charge of District No. 1; Robert Rosenbluth, Forester in Charge of District No. 2, Fred L. Pray, Forester in Charge of District No. 3.

MANAGEMENT OF THE PUBLIC FOREST IN NEGROS AND BATAN.—William Klemme, Chief of the Division of Administration; Harry N. Whitford, Ph.D., Chief of the Division of Investigation.

PLANS FOR THE REORGANIZATION OF THE PHILIPPINE FOREST SERVICE.—Hugh M. Curran, Forester, Division of Investigation.

Wednesday, June 9th.

CONSERVATION AND FOREST RESERVES.—William Dent Sterrett, Forester, Division of Investigation.

HOMESTEADS, SHIFTING CULTIVATION, AND LAND LAWS.—Robert Rosenbluth, Forester in Charge of Administrative Dist. No. 2.

EDUCATION AND PROPAGANDA.—F. W. Darling, Forester Division of Investigation.

NURSERIES AND REFORESTATION.—Theodore C. Zschokke, Forester, Division of Administration.

Thursday, June 10th.

PHILIPPINE FOREST TYPES.—Harry N. Whiftord, Ph.D., Chief of the Division of Investigation.

LICENSES, CONCESSIONS, COMMUNAL FORESTS.—William Klemme, Chief of the Division of Administration.

PHILIPPINE FOREST LAW.—Major George P. Ahern, Director of Forestry.

THE MUSEUM, TIMBER TESTING AND DURABILITY TESTS.—Edwin E. Schneider, Manager of the Timber Testing Laboratory.

Friday, June 11th.

THE INDIAN FOREST SERVICE AND THE QUESTION OF PERSONNEL.—Royal Freeman Nash, Forester, Division of Investigation.

THE PRINCIPAL TIMBERS OF THE EAST.—Fred W. Foxworthy, Ph.D., of the Bureau of Science.

BOTANICAL NOTES.—Elmer D. Merrill, Ph.D., of the Bureau of Science.

FORESTRY IN THE PHILIPPINE COLLEGE OF AGRICULTURE.—E. B. Copeland, *Ph.D.*, Dean.

THE COLLECTION OF FOREST CHARGES.—C. D. Gooch, of the Bureau of Internal Revenue.

Saturday, June 12th.

GRADING AND GOVERNMENT INSPECTION OF TIMBER.—Fred. L. Pray, Forester in Charge of Administrative Dist. No. 3. William Dent Sterrett, Forester Division of Investigation; A. B. Johnson, Manager of the Insular Lumber Company.

The custom, inaugurated in 1906, of bringing together the entire technical force of the Philippine Forest Service, together with the botanists and technologists of the Bureau of Science, the officials charged with collecting forest revenues, lumbermen, and others interested in forest problems, is largely responsible for the light which, in the Philippines, begins to tinge the dark in which lone forest services are born. In these annual conferences the broad lines of policy are threshed out, work performed and proposed is gone over in detail and criticized from the vantage-point so gained; the knowledge of our forests, which is being rapidly assembled by the Division of Investigation, is each year brought down to date and put at the service of whomsoever will use.

At the conference just adjourned, two addresses of wide scientific interest were discussed. Dr. Whitford in his paper on "Forest Types", dealt with the preponderant importance of the

Fig. 1.

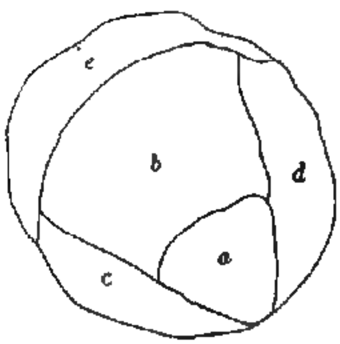


Fig. 2.

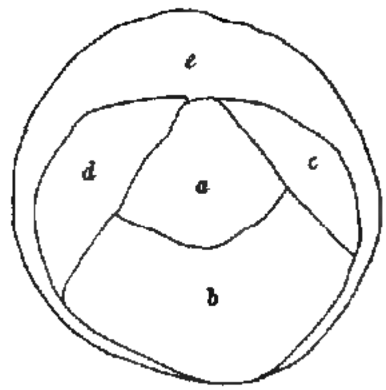
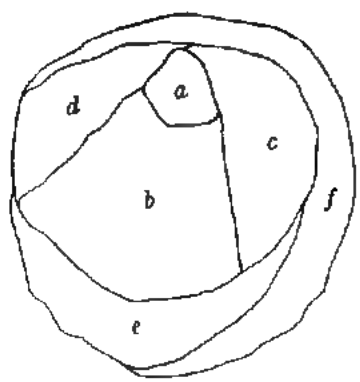


Fig. 3



Explanation.

	Fig. 1	Fig. 2	Fig. 3	
a	8″	12″	7″	Unformed leaf.
b	2′3″	2′3″	1′9″	Unformed leaf.
c	1″	1′3″	1″	Petiole.
d	1′9″	2′6″	1′9″	Do.
e	3′6″	2′9″	2′9″	Do.
f	—	—	3′6″	Do.

Horizontal Sections at ground level of the stem of three trees of Borassus flabelliformis, which had not developed an above ground stem.

Dipterocarp forest in these islands. Dr. Foxworthy's outline of his extensive studies on the timbers of the Malay Peninsula, Borneo and the Philippines, was an illuminating amplification of the same thesis from the standpoint of the wood technologist. These two articles may be found in a coming issue of the Philippine Journal of Science.

Mr. Curran's plan for the reorganization of the Philippine Forest Service, opens discussion on one of the pressing problems which must be attacked within the next few years. The present organization was created by the necessity of distributing a very small force of inspecting officials over sixty thousand square miles, until the Division of Investigation could make the surveys on which to base a comprehensive scheme for permanent administration. The land classification map of the Archipelago, and precise information on our chief bodies of timber is now sufficiently complete to afford the requisite data, and the Philippine foresters hope soon to quit the rough life of the explorer to enter on the splendid task of harnessing the jungle in the service of the world.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

WILD DOGS IN INDIA.

Readers of Kipling's fascinating *Jungle Book* will remember the story of Mowgli enticing a pack of wild dogs to the abode of the Little People—wild bees—and thence to meet, at a disadvantage, the wolf pack led by old Akela. The dhole, or wild dog, also inhabits the forests bordering on the Himalayan Terai, though in fewer numbers than in Central India These animals are hard to come across, a pack travelling long distances and seldom remaining for any length of time in one locality. The presence of wild dogs in a forest range annoys the forest officer, since they harry smaller game, especially the deer family, and even larger carnivora, such as tiger and leopard, accord right of way to the dhole rather than risk being attacked by those relentless brutes, for the wild dog is a marvel of stubborn perseverance, and seldom quits his prey till the latter is run down. It has never been my good fortune to see a pack actually pursuing other animals—to describe them in full cry would be incorrect, because they run in perfect silence; but I knew an engineer who witnessed a sight of that sort when trollying along a branch line in an Oudh forest tract. A fine blue bull nilghai rushed across the line with a score of wild dogs at his heels, neither hunted nor hunters paying attention to the trolly with its human occupants.

In appearance the dhole is of a rich tawny colour, the tips of the tail being black, and a good skin is a trophy worth securing, as much on account of its beauty as comparative rarity. Natives call it *ban kutta* (forest dog) in Oudh, and apply the epithet

"golden" to their colour, in much the same way as ancient ballad-mongers used to speak of the "red, red gold." Though not afraid of man, they rarely molest him, albeit some police chaukidars—employed to take messages from one thana to another through the forest—once submitted a petition about having been "treed" by a pack, and thus hindered in the execution of their duty. My first personal interview with wild dogs occurred in May, 1905, when visiting Motipur, a village on the confines of the Bahraich Forest in Oudh The local shikari brought word of a pack of dhole having taken up temporary quarters in the adjacent forest block and committing depredations, not only on nilghai and chital, but also on domestic animals owned by villagers, their last victim being a buffalo calf. The heat at that time of year is excessive; still, the prospect of getting some sport renders it more supportable to the hunter, while the chance of a shot at big game is greater than during the winter months. Tigers, for example, do not go so far after killing, and are as fond of the cool shelter of reeds (narkol) as is a jaded Londoner of a dip in the briny.

Next afternoon found me on the back of a favourite pad elephant, that rejoiced in the not very appropriate name of Gulab Kulli (rose bud). I proceeded down the cutting through the forest—known technically as a "forest line"—to the place where the shikari thought the pack would most probably emerge from the depth of the neighbouring jungle. A ride of a little over a mile brought us on to a plain, which lay between the forest and a big *jheel*, the latter a grand spot for duck shooting in the cold weather. Along the fringe of the woods was thick undergrowth, and the grassy plain was studded by clumps of low trees and bushes, behind one of which bits of cover I took up position. The shikhari had brought with him a live goat to act as a decoy and having fastened it securely to a stake driven into the ground, squatted down a little in rear of where I was sitting. From my place of hiding I obtained a good view of the open space between the forest and where the goat was tied, and nothing now remained except to wait patiently for the advent of wild dogs on the scene. Shikar, under these circumstances, is always a tedious business,

trying alike to nerves and temper. The air was oppressively close and hot, while myriads of mosquitoes from the swamp behind us added to the discomfort of the situation. The goat, too, as is so often the case, failed to play the game from a sporting point of view, nibbling the scanty herbage in silence, instead of maintaining a steady bleat. This cussedness is not unusual in the goat tribe when tied up as bait. They either gaze intently towards the jungle, as if aware of the approach of an enemy—thus making you stare your eyes out in eager expectation—or lie down like dumb mutes, resigned to whatever *Kismet* may have in store for them. In fact, their aggravating conduct might frequently tempt one to shoot the provoking beast in default of other quarry.

The shadows gradually lengthened; the shrill call of peacocks and jungle fowl showed that evening was at hand; yet no sign of wild dog. After waiting a little longer I left my ambush in disgust, and, beckoning to the shikari, walked along the skirt of the jungle in the hope of getting a jungle cock—a handsome bird, and good eating—for my breakfast next morning. We had not gone a couple of hundred yards from where the goat was tied (it had not been loosed from the stake) when a dozen or so of wild dogs trotted out of the jungle, their tawny coats reddened by the rays of a setting sun and the black-tufted tails leaving no doubt as to their identity. They did not notice the native and me, beyond uttering a few snarls as they ran across the open ground in the direction of the reeds, evidently not having scented the goat away to their right. Near the swamp the pack halted and looked back at us, thus giving me a decent shot at one of their number, and my trusty ·303 did the rest. The remainder of the dogs scampered back to the forest, while we hurried to pick up their dead comrade. Delighted at securing an envied trophy, and to find the skin was in good condition, considering the time of year, I returned to the clump of trees in order to recover a tobacco pouch, forgotten there, chatting meanwhile to the shikari whose pleasure equalled my own at the success of our expedition.

Great was our surprise, after the missing article was found and we were about to shout for the elephant to come up, to see six or seven dhole again breaking cover and coming straight for the goat. Crouching down behind a tree, I got a second—and easier—shot, the dog aimed at rolling over wounded, and unable to run back with its comrades to the jungle. As my supply of rifle cartridges in camp was limited, I put a No. 4 in the shot gun and advanced to where the wounded animal lay. Firing at it from quite a short distance, my surprise and disgust may be imagined when it scrambled to its feet and made off—at a fair pace, too—after the rest of the pack. The effect of the shot (for my aim had been true enough) was magical, and in place of acting as a *coup de grace*, had served as an electrical restorer, such as is now-a-days advertised in the daily Press. Of course, I had omitted in the hurry to load both barrels—one of those mistakes one is guilty of in the excitement of jungle shooting, and which are regretted and wondered at on the way home My spirits were somewhat damped at returning with one instead of two dogs; still, while Gulab Kulli tramped back to the little forest bungalow I reflected that luck had, on the whole, been propitious, and that the skin of a *ban kutta* would prove a welcome addition to such store of trophies as I already possessed.

Bar fleeting glimpses of wild dogs during a beat, my acquaintance with the dhole was not resumed till the cold weather of 1906, when a small pack suddenly appeared in the vicinity of Kakraha, the next camping place to Motipur, and situated in the heart of the forest, four "lines" meeting there, and the open ground consisting of a diminutive clearing of half an acre in extent. Without being a strict Sabbatarian, I make a practice of abstaining from shikar on Sundays, and found this custom earned the respect of natives, who, whether Mahommedans or Hindus, are tolerably strict in observing the laws of their own creed. However, there is no rule without an exception, so when a camp follower ran up with news of a pack of wild dogs, visible on one of the lines close to the bungalow, I cast the reins of resolution on the neck of desire (as an Oriental poet would say), and hastened to have a

shot at the venturesome visitors. I managed to bag one of the pack, but hit him too far back with the first bullet, so had a short chase through the undergrowth before being able to administer a necessary quietus in the form of a second shot. This skin was rather a better one than the former, and now I can point with satisfaction to two specimens of red dog on the floor of my little drawing-room at headquarters.—(*Forester in the Field.*)

THE WATCHES OF THE NIGHT.

There are many objections to shooting by night. There is something repugnant perhaps, to the best sporting instincts in lying in wait for an animal over its prey, or over a pool of water to which it resorts to quench its thirst, and thus taking it at a disadvantage. But the pleasure of sitting in ambush in a place frequented by wild animals at morn and at the setting of the sun, and throughout the hours when the stars shine overhead, is undeniable, even though one may not press the trigger of one's rifle. Then it is that one sees wild life at its best in the remote depths of the forest far from the haunts of man, where no sounds save those of nature fall upon the ear, and the wild beasts wander in peace over almost untrodden solitudes.

In such circumstances, the watcher generally takes up his position in concealment in a tree overlooking a pool of water about an hour before sunset. It is probably the height of the hot weathere that being the best season of the year for this work, for the jungle is then sparse, water is scarce, and the wild animals are impatient of thirst. Throughout the heat of the day nearly all living things have slumbered, the birds sitting silent and gasping with wide distended beaks, while the voices of the forest, save perhaps for the screech of the cicada and the monotonous call of the brain-fever bird, are hushed in the noonday sun.

But as the sun sinks behind the hills or the trees in the west all things come to life. A gentle breeze, herald of the night, stirs among the trees, and perhaps a small whirlwind brings a column of dust and dead leaves through the open spaces of the forest.

And as the embers of the day burn red in the west, Nature awakes. The forest is shrill with the incessant screech of the cicada ; the birds awake and twitter overhead in the evergreens and fly down to the water to quench their thirst. A troop of monkeys comes swinging from tree to tree, and with fear expressed in the grimaces on their dusky countenances as they look around for the lurking feline foe, they timorously approach the water one by one, the slightest sound sufficing to send them off chattering to the topmost branches. A barking deer or a little four-horned antelope comes down, and approaching the pool with dainty footsteps, digs its soft muzzle into the pellucid depths. A peacock, trailing six feet of green and gold, approaches with stately tread, followed by a bevy of more sober-plumaged hens , a jungle cock crows defiance from the brushwood and is answered by a rival close by. Larger forms, the sambar or the spotted deer, may be seen moving in the adjacent glades.

And now night's phantom army, the shadows of the forest, advancing across the face of the waters, spreads over the spaces so recently lighted by the setting sun. Stars faintly flicker in the darkening sky. The animals and birds have disappeared as if by magic, warned by the advance of night or by the approach of the destroyer. A stealthy tread is heard among the dry leaves scattered in the bed of the empty watercourse ; a panther is coming on velvet foot fall ; anon it pauses, then pads softly down to the margin of the water, a phantom form, a mere shadow, scarcely visible, so wonderful does its coloration blend with the deepening gloom. This is fair game for the rifle, although deer may not be shot over water.

Night watching is not by any means always successful. The first occasion on which I met with success was near a place in the Deccan where I was stationed. A panther had killed a calf about two or three miles out, and hearing of this I went out to the place and got into a tree about an hour before sunset, having tied up a goat below. In about half an hour the panther suddenly issued from the bushes close by and seized the goat by the throat. I fired on the instant, hoping to save the poor

beast's life, and the panther relaxed its hold and rolled over dead but the long canine teeth had already inflicted fatal wounds, from which the life blood was bubbling. Not long afterwards I was encamped near a village, where a panther had committed many depredations on the flocks. I tied up a goat near a pool of water where the beast was known to drink and got into a place of concealment constructed against the trunk of a large tree close by. It was a bright moonlight night, and for some hours I kept awake but nothing came. At about 2 o'clock in the morning I woke with that indefinable feeling, so often experienced, of the close proximity of a beast of prey. The goat, which was lying down rose to its feet and gazed intensely into the shadow of the bushes. And as I watched with my rifle ready across my knees, a panther appeared as if by magic, and crouched facing me and the goat which was between us. I fired, but, when the smoke cleared, looked in vain for any sign of the beast. It had vanished as silently as it appeared. In the morning I looked for marks of blood or bullet, but could find neither; only the panther's claw had dug deep into the dusty pathway. I have since thought that the animal must have been mortally wounded and died somewhere in the large extent of bush-jungle that grew around. For the flocks were henceforth free from depredation.

Three years later, I was out in camp at a place where several panthers were on the prowl, but for two days nothing could be found, and I searched the jungle in vain for the whereabouts of the beast. Then one morning when sitting outside my tent after breakfast I saw vultures, mere specks in the azure sky, circling round a small hill, to which they gradually descended. Proceeding to the spot, I found a large buffalo calf that had been killed by a panther during the night and partially eaten. My orderly constructed an ambush with the branches of tree and bushes against the hillside, leaving a small hole for me to shoot through, and the buffalo being dragged some six or eight feet from it, I took up my position behind this screen just before sunset. It was a dark night, but the moon would rise at about 9 o'clock. I dozed off to sleep, but awoke a couple of hours later, between 9 and 10,

with that same indefinable feeling of the presence of a feline beast of prey. And as I gazed through the aperture in front of me, I saw the carcase move, and a moment later the round head of the panther, with champing jaws, appeared from behind. The beast was looking straight at me, with its paws on the carcase. Again the head went down, and the animal resumed its feast, and then again raised its head as before. This time it received the contents of my gun, a charge of slugs, full in the face; it disappeared, and then I saw its long tail beating the ground convulsively. When all was still I emerged from my hiding place, dragged the dead panther in behind the screen, and waited in hopes of another one coming; but nothing more appeared. These few successes were among many weary unsuccessful vigils, and since those days I have done but little night shooting, preferring to trace the animals to their lair by daylight and drive them out with a line of beaters.

Some years ago, however, I was encamped for ten days in the depths of a great forest, where there was game in abundance, principally bison, and bears, and deer. Tigers were scarce, but one night a tigress killed and partially devoured one of my buffaloes near a pool of water, a few miles from camp. Next morning I was out after bison, and the men who went to look at the buffalo were warned off by a growl from the beast which had killed it. Again they attempted to approach, but the growling increased in volume and ferocity. In the afternoon, having returned from an unsuccessful pursuit after a great bull, I went down to the place. The tigress had gone, and as the men had disturbed her, there seemed to be little prospect of her return to resume her feast on the carcase, half of which remained. There was a chance, however, so I had a platform constructed in a tree overlooking the water, and took up my position on it before sunset, sending my men back to camp, for I intended to remain all night.

Soon a barking deer barked repeatedly up the ravine, sure sign of the passage of some beast of prey. Another took up the cry of alarm, and nearer this time; I hoped the tigress was

approaching It was now getting dark. Some large animal came out of the bushes and down to the carcase I grasped my rifle and peered into the deepening gloom. A strong effluvium came up from the remains below, at which a heavy beast with a striped body was tugging But it was light enough for me to see that the animal was a hyena, and I drove it away by throwing a cartridge at it. It was now quite dark, but the moon soon rose and lighted up the scene below; only the bright light threw into stronger relief the black shadows of the forest behind me. Sometimes dozing off to sleep, sometimes wide awake, I found the hours drag slowly; but at about two in the morning there was a crashing noise in the jungle behind me, and a great bison came down and suddenly stopped; I feared to turn lest he should be frightened away for he was evidently coming for a drink at the pool, and I hoped he would not be alarmed But suddenly he stopped, and, looking over my shoulder, I could see him standing with head thrust out looking either at me, or at the carcase of the buffalo, which he must have scented. He snorted for some time, stamping with his feet and tossing angrily with his head; and then he suddenly turned, and rushed back into the shadows of the forest, where for some time I heard him tearing up the ground with feet and horns

Nothing more came near my ambush, and when dawn arrived and the gathered mists of night dispersed, my men came and I descended from my perch. And then we sought out the tracks of the great bull bison I had seen and there ensued a two days' hunt. But that is another story. (*Nomad in the Indian Field.*)

PREPARATION OF THE SKULLS OF ANIMALS

The process now adopted of bleaching the skulls of animals is that of placing them in a solution composed of equal parts of methylated spirit and peroxide of hydrogen. The skulls should be first properly prepared by maceration. This should be carried out in the following manner: First the brain is removed through the *foramen magnum*, a hole at the base of the skull, and at the

same time as much as possible of the soft tissues from the outside of the skull. Secondly, the skull is immersed in water in a covered jar and allowed to macerate, but this operation must not be too prolonged, or the bones might drop apart, the time depends on the size of the skull. Thirdly, wash the skull in running water, put it into a saucepan full of cold water, and bring the water very slowly almost to boiling point; the remains of the soft tissues on the outside of the skull will now come away quite easily. Fourthly, immerse the skulls in methylated spirit and peroxide of hydrogen in equal parts until bleached. Finally, dry and cement in any loose teeth. This process is sufficient for most skulls, but may not always succeed in very brown specimens. It further has this advantage, that no injury is done to the bones, however long they may be immersed in it. If the skulls are at all greasy, they should be first soaked in petrol or benzoin to remove the fat; the petrol being afterwards got rid of by plunging the skulls into hot water.—(*The Field.*)

SILENT RIFLES.

NOISE, FLASH AND RECOIL OBVIATED.

Rifle shooting without noise will be the next feature in warfare—no noise, no flash at the rifle muzzle.

Mr. Hiram P. Maxim recently gave a demonstration of his silencer for guns and rifles at the King's Club, Jermyn-street, where a variety of rifles were fired in a small rifle range, four feet of sand being behind the targets.

Mr. Maxim first fired each rifle without the silencer, when the noise produced was demonstrated by means of a Borland sound recorder, an instrument in which the sound, received by a small megaphone, is made to throw up a little ball suspended by a delicate thread. The greater the sound the higher is the ball thrown up.

With the silencer in use no effect was produced on the recorder while without it the ball was in some instances thrown violently against the top of the instrument.

The silencer takes the form of a small cylinder, which fixes easily, by a quarter of a turn, on the muzzle end of the rifle barrel. Inside it is what practically amounts to a negative turbine—*i.e.*, a series of fixed "blades" which cause the gases of the explosion to assume a rotary motion. In turning rapidly round in this way their energy is absorbed and turned into heat, the sound being destroyed owing to the waste of the energy against friction

The most remarkable result was produced with a British service rifle, which made a deafening noise in the small shooting gallery. With the silencer on, however, there was practically no noise whatever.

Both the flash at the muzzle and the recoil are also practically done away with, the latter being reduced by about 60 per cent, the former completely.

To demonstrate how the force of the gases, which are at a pressure of something like 10,000 pounds per square inch at the muzzle, is destroyed, Mr. Maxim held in his fingers a visiting card in front of the silencer while a service rifle was fired. A small hole was merely blown through the card When, however, the experiment was repeated without the silencer, a piece of cardboard being held on a stick in front of the muzzle, the cardboard was completely blown to pieces.

The silencer necessary for the British service rifle weighs only eleven ounces and is about five inches long. It does not in any way interfere with the sighting, the chief bulk of it coming below the barrel.—(*Daily Mail.*)

EXTRACTS FROM OFFICIAL PAPERS.

REVISED RESOLUTION REGARDING THE ADMISSION OF CONSERVATORS OF FORESTS TO THE SPECIAL ADDITIONAL PENSION.

Government of India's Resolution No. $\frac{16}{218-1}$ *F., dated* 16*th June* 1909.

In supersession of Revenue and Agriculture Department Resolution No. 26 F—214—4, dated the 12th December 1908, the

Governor-General in Council, with the sanction of His Majesty's Secretary of State, is pleased to direct that in future all Conservators of Forests who have rendered not less than three years' effective service in any grade may, provided they have shown special energy and efficiency during such service, be allowed by the Government of India an additional pension of Rs 1,000 per annum under article 475 of the *Civil Service Regulations* (4th edition), subject to the condition that, if a Conservator voluntarily retires and has served only in the Second or Third Grade or has rendered less than three years' active service in the First Grade, he must have completed 28 years' total qualifying service in order to be eligible for the concession.

2. The necessary additions will be made to article 475 of the Civil Service Regulations.

FOMES LUCIDUS (LEYS) FR.

Drawn by E. J. Butler.

VOLUME XXXV NUMBER 10

INDIAN FORESTER

OCTOBER, 1909.

THE MIXED TEAK FORESTS OF THE SAUGOR DIVISION, AND THEIR TREATMENT.*

As most forest officers serving in the Central Provinces are more or less familar with the type of mixed teak forests dealt with in this paper, a detailed description of the growth is hardly necessary. It is sufficient to say that these forests are of the somewhat unattractive Vindhyan type, teak forming from 30 to 50 per cent of the crop and seldom rising above a height of 40 feet. As the Saugor peasant generally insists on using teak, when he can get it for all purposes, and is slow to learn the merits of second class woods such as Saj, Tinsa, and others, it follows that the long-suffering teak has had much to contend with in the past. *Only its* marvellous vitality has enabled it to survive the merciless course of lopping and pollarding to which it has been subject from time immemorial. It appears to be a special dispensation of nature that the teak, which has had the most to endure at the hands of man in the past, has a greater power of resistance than its chief associates.

* This paper was read at the Central Provinces Forest Conference in November 1908.

This is clearly seen in many of the fast disappearing village forests in the Saugor district, where the stage preceding utter desolation is often a scrubby and bush-like growth of teak, all other forest growth having given up the hopeless struggle to cope with village "nistar" as generally understood and practised.

Fortunately the Government forests, though mostly poor in themselves, are many degrees removed from this state of ruin, and contain possibilities for the future which it is the duty of our department to develop. Mature teak are generally distorted by frequent lopping, and even young poles have not escaped the same fate. Vigorous young coppice shoots of teak unfortunately find favour in the eyes of the Saugor peasant as being efficient substitutes for bamboos, so that a really sound, straight teak tree of over two feet in girth is something of a rarity. Seedlings are generally conspicuous by their absence, and in many of the forests it must be admitted that regeneration by seed is almost entirely wanting, or proceeds with extreme difficulty and slowness.

The method of treatment prescribed for these forests is coppice with standards, which meets present requirements and calls for the exercise of comparatively little skill on the part of a mostly untrained staff. For the present coppice reproduction of nearly all species may be relied on with certainty, and the ground is recovered as soon as possible after the felling—a notable advantage on the arid slopes and frosty hollows with which the Saugor district abounds. There can be little doubt, however, that sooner or later the management of these forests will present problems which are apt to be overlooked in the simplicity of the present working. It is a question for careful study how the continuance of the forests is to be assured. We at present know little or nothing as to the longevity of coppiced stools of teak and other local species. Great stress has been laid upon shoots which issue on or near the ground level developing root systems of their own distinct from that of the mother tree. The extent to which they actually do so appears somewhat uncertain, but in any case it seems only too clear that such shoots can never acquire the characteristics and expectation of life of seedling trees. This is made evident by the abnormally

early age at which coppice shoots flower and seed I have found teak coppice poles 10 years old and 25 feet high flowering profusely and yielding apparently healthy seed, and it seems to be a law in both animal and vegetable kingdoms that precocity in this respect means early maturity and a comparatively short term of life. No doubt the vitality of teak stools is great, as is shown by the manner in which they continue to produce shoots year after year on annually cleared boundaries and fire lines, but they cannot last for ever, and it is possible that, even with a comparatively long coppice rotation, they may fail us sooner than we think. The amputation at stated intervals of the whole of the assimilating organs, which have to be hurriedly replaced by the root system, must be a strain on the latter which can hardly fail to reduce its longevity. It is clear, therefore, that if these forests are to be managed as coppice in perpetuity, we must look to the provision of an adequate supply of seedling stems to replace the present stock of stools when these are exhausted.

The paucity of natural reproduction from seed already referred to is thus an extremely serious matter, and its causes appear to me to require even more careful enquiry, observation, and experiment than they have yet received. In the meantime we must provide for the future as best we can by the reservation of a good proportion of healthy standards, whereby we encourage natural reproduction from seed if we cannot actually ensure it. Doubt has been cast upon the fertility of the seed borne by teak coppice shoots, and I understand that this is at present under experiment. There is no apparent reason why a fair proportion of the seed yielded by coppice shoots of moderate age should not be fertile, but if it is found to be otherwise, then the paucity of teak seedlings in these forests will be at once explained, since there are few teak now standing which have not been more or less irregularly coppiced at some period in their life history. The result of the experiment with coppice seed will be awaited with interest by all who are concerned with the management of such forests. Should it appear that this seed is useless, or nearly so, there will be a strong case for increasing the number of standards (at present 50

per cent per acre in Saugor) and, where natural means fail, for further experiments in the sowing of healthy seed *in situ*, as is done in many European coppice forests.

Coming now to the fellings in these mixed teak forests, distinction may be drawn between—

(i) Regular coppice fellings.

(ii) Improvement fellings.

The regular coppice fellings are on a rotation of 30 years. About 50 standards per acre are marked for reservation during the previous hot weather and rains, and the coupes are, as far as possible, sold standing to lessees. The stereotyped form of agreement with lessees makes the latter undertake to fell everything in the coupe exclusive of the marked standards, fruit and lac-bearing trees, bamboos, and saplings below a certain girth. Where fuel is marketable this thorough clearing of the coupe can be, and has been, insisted on with advantage. But in the remoter felling series where fuel is unsaleable, or is saleable only in small quantities, it is found necessary to be content for the present with something short of complete coppicing over the whole area. Rigid insistence on the coppicing by lessees of large quantities of unsaleable material would only result in the discouragement of the latter and in the indefinite postponement of any form of regular working. To meet cases where the demand on the remoter felling series is only beginning to develop, lessees of such coupes are permitted to practise a sort of "modified coppice" or "selection coppice" felling They are under agreement to coppice *all* unreserved trees of such species as are saleable locally as timber, and to cut back any trees or inferior species which may be injuring more valuable growth, or which may be likely to suppress shoots from the stools of the better species. The timber species which the lessee is compelled to coppice vary in different felling series. In the remoter series it may be teak alone, and in others teak, Saj and a few of the other second class woods. The cutting back of these is the first operation carried out in the coupe, and when this is complete, or approaching completion, the area is inspected by the range officer who marks with a broad blaze the trees of

inferior species which must be removed for sylvicultural reasons. Any tendency on the part of the lessee to shirk this stage of the work after he has extracted the plums can easily be met by enforcing the penal clauses of his agreement bond, which provide adequate penalties for any breach of the conditions attaching to the lease. As a matter of fact it is not found that the removal of such inferior species as have to fall for sylvicultural reasons is a very formidable undertaking in these thinly stocked forests. The rapid growth of teak coppice during the first few years of its life and the remarkable power of the shoots of pushing their way through overhead cover, enable them to succeed without any assistance in the great majority of cases. In actual practice I have found that the shoots are safe so long as a teak stump has nothing directly above it. They can stand plenty of side shade during early life and can easily hold their own if they have light directly overhead. In a few years they are practically on a level with the rest of the crop in these thin and stunted forests.

This form of "selection coppice" felling may be objected to on the score that it is not a regular sylvicultural system, and it is true that it does not find a place in Schlich's Manual. But under the conditions with which we have to deal, we generally have to be content with something short of the ideal, and all that is claimed for the above is that it is a serviceable makeshift. I supplies and fosters the present limited demand on the remote coupes to which it is applied, and at the same time effects a real improvement in the forest crop by replacing all undesirable and deteriorating stems of the better species with healthy coppice growth. Undoubtedly if the text-book be rigidly adhered to everything but the standards should be cut, but the only result of this would be to discourage any form of regular working for the present, and perhaps to stop it altogether. The coppice system can be reduced to an absurdity by slavish adherence to rules when these are applied by untrained subordinates, and I have actually seen Thuar *(Euphorbia neriifolia)*, which produces no coppice shoots, cut back at considerable expense on a stony slope where it was almost the only soil covering! But even when inferior

species coppice readily, as most of them do, it does not appear that any useful purpose is served by coppicing them when they are interfering with nothing of greater value, and, being quite unsaleable, would only remain to rot on the ground or increase the intensity of forest fires. Species which are only used as fuel are little more suitable for that purpose in the shape of straight coppice poles than in the forms in which they naturally occur in these forests, and there is no sylvicultural or economic reason why, under present conditions, money and labour should be expended on growing fuel-yielding species in one shape rather than in another. If the felling is properly supervised, their retention can do no harm, and may well be beneficial in keeping the soil covered, and in protecting the shoots of the better species against the effects of frost and drought where these dangers are to be feared.

For some years past a series of improvement fellings has been carried out departmentally in the Saugor division. These fellings have been chiefly confined to such coupes of past years as have remained unworked, or have been partially worked by license-holders or lessees who have cut only the best of the unreserved poles. These improvement fellings are somewhat similar to the "selection coppice" described above, consisting of the cutting back of all badly shaped and sickly specimens of the timber yielding species, which may be teak only or may include some of the second class woods according to local conditions. At the same time all inferior species suppressing, or likely to suppress, more valuable growth are cut out or girdled. The operation is one that does not call for a high degree of skill, and it is found that a fairly intelligent forest guard, after some instruction, can direct it efficiently under the general supervision of the range officer and his assistants. Thus no expense is incurred on a preliminary marking of the trees for felling, as these are chosen by the forest guard and pointed out by him to the labourers as the work progresses. The ordinary programme of improvement fellings for the year 1907-08 was more than doubled in the Saugor division as a measure of famine relief. In all an area of about 2,320 acres was treated at an average cost of about 13 annas 8 pies per acre. The

number of trees felled per acre averaged 35, the cost of the work being thus a little under 5 pies per tree. From these figures some estimate may be framed of the rich return which may fairly be expected from the comparatively trifling expenditure incurred. The trees felled (mostly teak) had no future before them, and were likely to deteriorate rather than increase in value. The stools may fairly be expected to produce on an average at least one good coppice shoot apiece, and these shoots in another 30 years will be worth not less than 8 annas each as they stand—probably far more, as the long threatened timber famine should by that time have declared itself. The cost of felling, with compound interest at 4 per cent, will by that time have amounted to about 1 anna 4 pies per stool, so that, at a conservative estimate, the net return will be at least 6½ annas per tree, or in round figures Rs. 33,000 on the operations of 1907-08, which cost only Rs. 1,990. These figures are admittedly not much more than guess work, but they have a sufficient basis of fact to support the Forest Department in asking for funds to extend such fellings even in places where their yield is at present unsaleable, and where they bring in no immediate return.

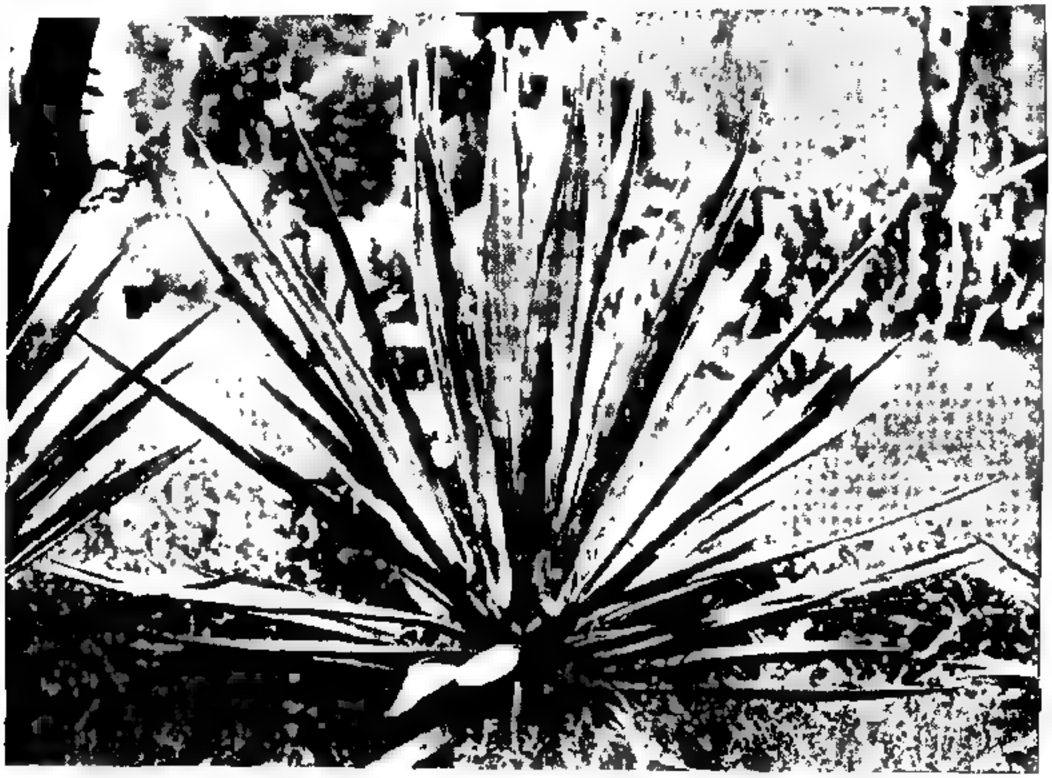
I shall conclude with a few words as to the season of the fellings and the mode of executing them. Experiments, which I believe are confined to the Northern Circle, have been in progress for some time to ascertain whether coppice reproduction is affected in any way by the season at which the mother trees are felled. No results have as yet been published, but so far as my own observations go, I believe it to be true that the proportion of stools which fail to yield shoots is greater among trees felled during the rains (July to October) than during the remaining eight months of the year. This is only what might be expected, as it is generally admitted as an axiom that fellings should proceed when, in common parlance, "the sap is down," and that preferably they should be completed at least a fortnight before vegetative activity commences, so as to allow the root stool a short interval to recover from the shock which it has sustained. The point is one of some importance in these forests, where we depend so largely on coppice

reproduction, and fellings are now stopped in the Saugor division from July to October. I believe that in some parts of the provinces it is still the custom to coppice in the rains, the timber obtained from such fellings being held to be more durable than that cut at other seasons, and it would be interesting to hear what have been the sylvicultural results of such fellings as compared with those executed at what is theoretically a more suitable time.

As to the mode of coppicing, it is possible that too much stress has been laid in the past upon the trimming of the stools with smooth surface sloping from the centre. There is a regular staff of forest labourers near most of the Saugor felling series who have been carefully trained to this work year after year, and many of whom are now inclined to carry the trimming process too far. When employed on a daily wage, a man will sit chipping a stool till the surface almost suggests the use of a jack plane and sand-paper. It seems likely that, so long as the stems are felled at ground level, refinements of trimming are wasted labour.

Greater care should, however, be taken with trees which are approaching the limit of coppicing age and whose coppicing power is doubtful. It is noticed that in such stems the bark at the ground level readily dries up and separates from the wood, and that when this happens all hope of coppice reproduction is at an end. The greater care is therefore necessary to avoid any injury in coppicing which might increase the danger of such separation, and the chances of success may be augmented by careful trimming, which is hardly necessary in ordinary cases.

C. M. McCRIE,
Divisional Forest Officer,
Saugor Division.



1. *Agave rigida:—variety sisilana. (no teeth).*

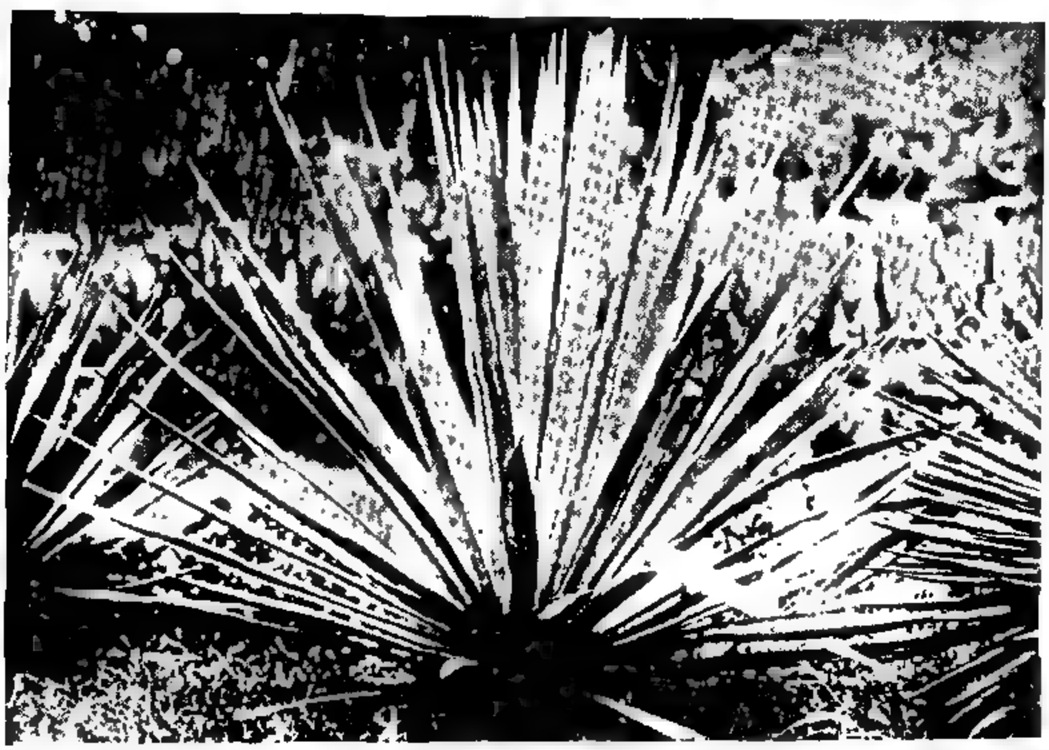


Photo-Mechl. Dept., Thomason College, Roorkee

2. *Agave rigida:—variety elongata (notice the teeth)*

ORIGINAL ARTICLES.

FIBRE PRODUCING PLANTS IN INDIA.

INDIGENOUS AND IMPORTED.

Since writing the letter on "Aloes," which appeared in the September number of the *Indian Forester*, we have received a letter from the Inspector-General of Prisons in the C. P., who is keenly interested in finding suitable work such as aloe-pounding for convicts in his jails. This work has several advantages apparently which might not readily strike the lay mind: in the first place it affords an excellent form of penal work, as it demands considerable energy and so possesses an advantage over other and more sedentary forms of labour: in the second place aloe leaves are not edible, not even by convicts, and this is also an advantage since there is no temptation to them to steal it. The Inspector-General is so impressed with the idea and with its possibilities in the way of extension through the instrumentality of the Forest Department, that he has written to all Conservators and Jail Superintendents on the subject.

We would therefore draw the attention of the Imperial Forest Economist to this possible source of profit with little cost or labour to the department, when he gets tired of working up matches, tea boxes, and the like, and would also mention that there appears to be a demand in the Jail Department for oil-seeds, such as Mohwa *(Bassia latifolia)* for instance, and probably many more which he knows better than we do, and which are at present very neglected in these provinces at least.

It is also possible that in the following extracts from a pamphlet written by Captain Liston, I.M.S., at the request of the Inspector-General of Prisons, C. P., and obtainable from the latter, we may be able to turn the tables on the Economist in the way of giving and not receiving information for once: and failing this, they may be found of interest by other forest officers:—

The two best known and most valuable varieties of aloes are *Agave rigida*, var. *sisalana*, and *elongata*: while the common

agaves of the C. P. are *Agave lurida* or the large grey agave, *Agave vivipara*, and the common narrow leaved grey agave, (variety unknown).

These agaves are not properly speaking aloes, being incorrectly so-called : they belong to the natural order *Amaryllidaceæ.* They are all monocarpic perennials, *i.e.*, they grow leaves only for a certain term of years, when they flower, wither, and die.

They are technically said not "to flower" but "to pole," this being an allusion to the curious pole-like flower-stem that results.

The plants "pole" according to the variety after varying periods, which in India are usually from 15 to 20 years.

Lateral branches develop when the "pole" is some 10 feet high, and on these appear successively the flowers, the capsules bearing seeds, and sometimes also bulbils or young plants

This again depends on the variety *A lurida* usually producing seed capsules, and *A. vivipara* and the common C. P. agave (name unknown) bulbils.

In addition the majority of species produce "root-suckers," and by this means are perhaps most easily and quickly multiplied, since they are produced from one year and upwards and throughout the plant's life, whereas, as noted above, they only flower once. They are most vigorous however in 5 year-old to 10-year-old plants.

All "aloe" plants have long stiff leaves terminating in a sharp spine ; but the edges of the leaves may or may not be furnished with teeth : these are always present in the variety "*elongata*" and generally absent in variety "*sisalana*," and is a ready means of distinguishing them, as the accompanying photos (Plate 21, Figs. 1 and 2) show. The width of the leaf is another distinguishing feature. Messrs. Mann and Hunter publish a book under the auspices of the Indian Tea Association on Sisal hemp or "Aloe" culture, in which this point is emphasised.

All the best fibre-producing species have rigid leaves, which become more and more horizontal however as they grow older. A distinguishing characteristic of the common indigenous Indian species is their less rigid leaves, which also bend over at the point as they grow older.

The flower is usually the only certain means of classifying these indigenous Indian species, but a rough colour-classification by leaves of the more common and best known is that given by Major Prain, as follows :—

A. Leaves rather light green.	(1) Leaves short: *Agave vivipara*—fibre good.
	(2) Leaves large: *Agave sisalana*—fibre good (Plate 21, Fig. 1).
B. Leaves dark olive green.	(3) A Punjab naturalised species (name unknown)—fibre of doubtful value.
C. Leaves grey ...	I.—Leaves softish and bending over at the point, prickles along edge of leaf; leaf large and broad.
	(4) *Agave lurida*—fibre of medium quality.
	II.—Leaves narrow.
	(5) Common grey C. P. and Cawnpore species, sometimes confused as *Agave vivipara* in Bombay; name unknown :—fibre good (Plate 22, Figs. 3 and 4).
	III.—Leaves rigid; numerous small prickles along the edge.
	(6) The grey aloe of Burma; name unknown—fibre not tried.

While these plants will grow on soils often unsuitable to other growth, they do best on mediumly rich to rich soils, and only repay cultivation on these

They mature within 4—5 years, from which time up to 15—20 years, when they flower and die, they are capable of yielding ½ a ton of dry clean fibre per acre or per 500—800 plants roughly, per annum, 500—600 on good black-cotton soils, and 800 on poor light stony soils.

Carefully machine prepared fibre from the common grey C. P. variety is worth £33 or say Rs. 500 a ton in London; while hand prepared or "retted" fibre may fetch only £12 or Rs. 180 a ton.

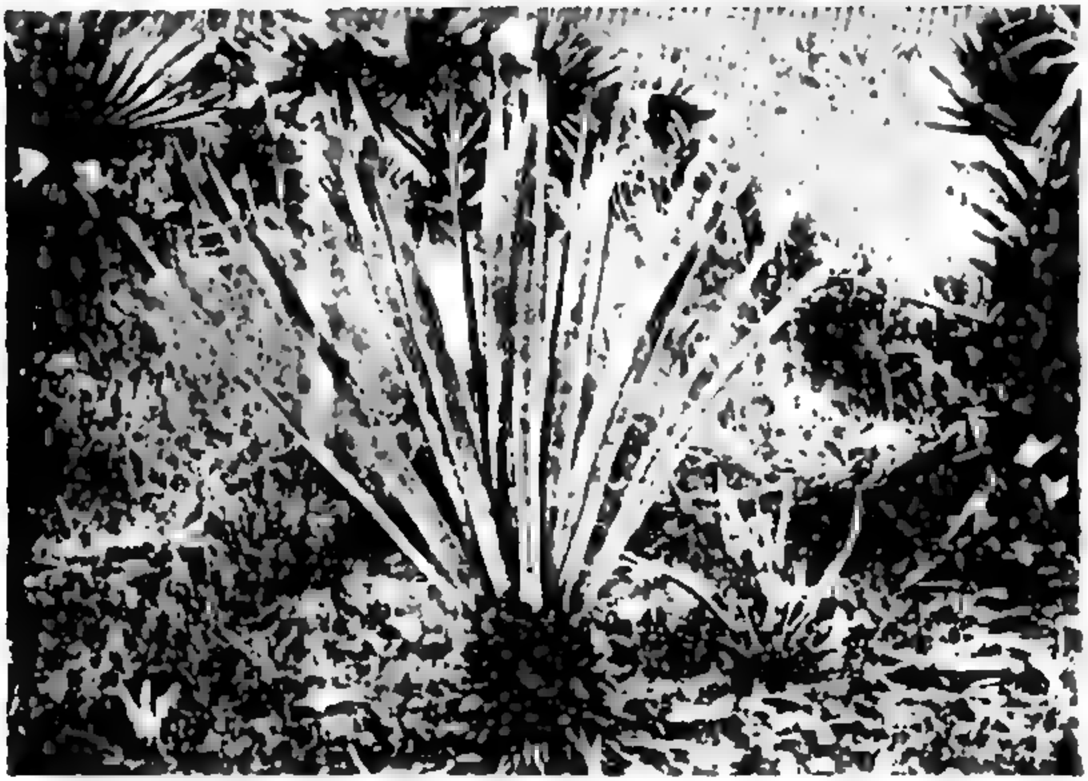
In one instance quoted, hand "retted" fibre from the common grey C. P. species fetched Rs. 190 per ton, and cost only Rs. 76 per ton to cut and clean, or a net profit in India of Rs. 114 a ton. This would have been materially more had it been machine separated.

There is no question of *Agave sisalana* being the most valuable and the best to cultivate commercially, since it is calculated that it is more than twice as valuable as the ordinary C. P. indigenous variety. It, however, becomes a question in such cases, especially under the conditions under which it would be grown by the Forest Department whether the common variety might not pay best in the end owing to its possibly greater hardiness and less susceptibility to climatic and possibly unfavourable conditions that might obtain, especially since acreage would be of no importance, ample area being available. This would be a question to be decided by actual experiment, but if two indigenous plants could be reared more easily than one American variety, obviously the advantage of the latter largely disappears. A somewhat similar analogy exists in the lac from Palas (*Butea frondosa*) and from Kusam (*Schleichera trijuga*): the latter is far more valuable, but Kusam trees are scattered and comparatively rare and very local in their distribution, while Palas trees are almost everywhere in abundance in these provinces.

The yield from *Agave sisalana* on average soils is 20 to 30 lbs. per plant per cutting: specially well developed plants may yield up to 50 lbs. The average yield per acre is estimated at about 10,000 lbs. per acre per annum, or per 600—800 plants.

That from the common grey C. P. aloe on the other hand is only about 2,000 lbs per acre per annum, or one-fifth of that of *Agave sisalana*.

I would draw attention to one curious fact, and that is, that while in most cases the "aloe" is grown on black-cotton soils, in one case, that of the Government experimental plantation of *Agave sisalana* at Poona, it has been planted on *muram* land covered with grass. Now my experience is that it is very rare, if at all, that any species of tree or plant does equally well on these



3. The common grey C. P. agave (variety unknown)

Photo-Mechl. Dept., Thomason College, Roorkee.

4. Plantation of common indigenous grey agave (unknown) of C. P.

two soils, as they seem to contain some chemicals or other constituents that are entirely opposed to one another and inimical to the plant life which prefers each, and I should suggest that the *muram* plantation is a mistake, seeing that the aloe grows so well and vigorously on black-cotton soils. That my contention is probably correct will be seen from the fact that whereas on good black-cotton soils the average growth of *Agave sisalana* leaves is shown to be 2½′ in poor and 4½′ in good quality soil, on the *muram* they were only 2′ to 3′ high, and it was observed that their growth was slow.

I will pass over the question of nurseries as we are not going to turn into market gardeners if we take up the cultivation of "aloe," but should risk a smaller outturn and occasional failure perhaps in return for the trouble, time, and money saved. Also the experiment here in Mandla with the indigenous species, as I imagine it to be, shows that it can be most successfully propagated by fire-watchers, who, as every forest officer knows, are not to be accounted in any way either skilled or intelligent. All that is required is to collect the young root-suckers or the bulbils and to plant these out in the ordinary way and not on mounds. Root-suckers are best separated with the underground rhizome, which is jointed like a bamboo, complete, and then the latter is divided up into two or three sections as the case may be and planted separately.

On poor soils the plants may be put out at 3′ to 4′ apart and on rich soils at 6′ apart: this is said to correspond to from 800 to 600 per acre, but I confess I am unable to arrive at these figures, and it would appear either that the spacing is underestimated or the number per acre* The best hand machine for the extraction of the fibre is said to be that of the Revd. R. Winsor, Senior, Poona District (Plate 23, Fig. 6), and it appears to give excellent results. It is worked as follows:—

The leaves are first gently beaten to split them: each leaf is then shred into two, three, or more lengths to suit the strength and

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* It takes 4,840 plants set 3′ apart each way, 2,722 plants 4′ apart or 1,210 plants 6′ apart for one acre.—Hon. Ed.

skill of the worker. With one foot acting on a system of levers, a knife is raised and a portion of a leaf passed under the blade, which is then lowered on the leaf by relaxing the pressure of the foot on the levers. The leaf is then pulled through under the knife which cleans it of pulp. The portion of the leaf held before in the hand is then treated similarly, so that a strand of fibre finally remains in the operator's hand: this is thoroughly washed with water and dried in the sun.

Power machines for working on a bigger scale are the Van Baren machine from Florida and the Lehman from Manchester, but a small oil engine would be required to work these as bullock-power has not proved successful.

The most important points to observe to ensure success are the following :—

Planting out.—The plants should not be shoved any way into the soil, but be put into carefully prepared holes 2' in diameter and 1½' deep. The soil from the holes should be sifted, all stones removed, and a small amount of good light manure added if possible: the holes should be partly filled in and then the plant carefully placed in the hole, not too deep, and care should be taken that no earth or soil gets among the leaves at the base. Earth is filled in round the *roots only*. Planting is best carried out during or immediately after the rains.

The above procedure refers really to nursery raised plants of 1½' height: where bulbils or root-suckers are planted directly, such precautions and elaboration will not be required.

If good species are imported, the "sets" should be obtained from reliable and authentic American or other sources.

After treatment.—(1) All rank vegetation, grass, and especially creepers, if any, should be cut down from time to time immediately round the plants if they show any sign of being choked.

(2) All root-suckers should be removed when 3' to 4' high and be planted out elsewhere, as they otherwise will be found to absorb much of the strength of the parent plant, and retard the latter's development.

(3) Leaves should never be cut from plants under 3′ height. Also leaves under 3′ length should seldom be cut.

(4) The leaves should be cut with a sharp knife as near to the stem as possible so as to have no butt ends, and only those should be removed that make an angle of 45° *or less* to the horizontal in the plane through the long axis of the plant and at right angles to it.

(5) The plants thrive best if occasionally watered with a mixture in water of the green pulp removed from the leaves, and it is a convenient and economical way of disposing of this refuse.

This operation of course would probably be omitted in forest or boundary plantations.

Points affecting the market value of the fibre.—These are length, strength, whiteness, gloss, and regular arrangement of the fibre :—

(*i*) Length is obtained automatically by cutting no leaves under 3′ in length.

(*ii*) Strength is mainly inherent in and a characteristic of the species of agave cultivated. That of *Agave sisalana* is the strongest. The method of extraction, however, also affects the strength very much, the machine-extracted fibre being far superior in strength to that extracted by the hand-retting process.

(*iii*) Whiteness is most important and depends on the degree of success attained in removing the gum that surrounds or coats the fibre. Careful washing conduces to whiteness of fibre. Washing in warm water is preferable to and gives better results than cold water.

Proper drying and bleaching also affect the colour properties of fibre very much. The fibre should be placed in a slightly shaded place in very thin layers and turned occasionally to facilitate drying. It should only be stored when perfectly dry.

(*iv*) Gloss is chiefly imparted by the machine-extractor generally speaking the better the fibre is cleaned the more glossy it will be.

(*v*) Fibre arranged in more or less regular parallel strands fetches a better price than in a tangled mass, and combed fibre than uncombed or matted fibre.

A simple combing machine consists in a series of nails in a row, points upwards, set in a piece of wood arranged at any convenient height. The dry fibre is grasped in the hand and rapidly thrown on and dragged through the rough comb.

Other fibre plants possibly worth introducing are *Furcræa gigantea* (Plate 23, Fig. 5) whose habitat is Mauritius. The fibre is finer but not so strong, and the weight is also less than in *A. sisalana*. On the other hand it is not eaten by cattle as is *A. sisalana*, and this is an important point to remember, and also in introducing *A. sisalana* into our forests: it is also not attacked by crickets as are other agaves sometimes.

There are three common species of *Furcræa* in India, *viz.*, *F. gigantea*, *macrophylla* and *sellodna*. One or both of the two latter are common in the C. P.

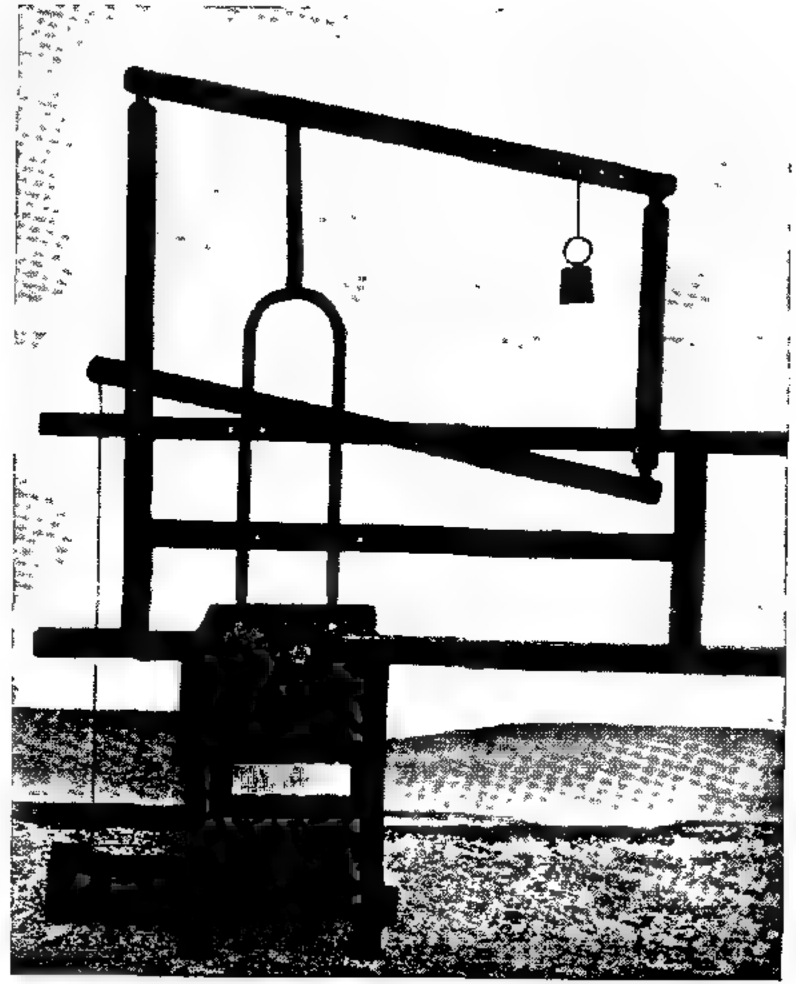
F. gigantea is by far the best of the three. It is characterised and distinguished by its rough sand-papery-like leaves (on the back): whereas the two other varieties have smooth leaves (on the back). *F. macrophylla* has medium green leaves, and yields a good fibre: while *F. sellodna* has pale green leaves, and gives a fibre of doubtful quality.

F. gigantea has stiff rigid leaves like those of *A. sisalana*, and yields a larger quantity of fibre and that of better quality than the common C. P. grey aloe. Another valuable fibre-producing plant indigenous to India is *Calotropis gigantea* and it will grow where *A. sisalana* will not thrive, or may be planted along with the latter as it is a quicker growing plant. It grows wild almost everywhere but its commercial value is little known.

It is described in detail in Dr. Watt's Dictionary of Economic Products, Vol. II, pp. 34—49. A sample has been valued at £90 a ton in Bombay: it also produces rubber of good quality but which unfortunately conducts electricity. Fibre has been successfully extracted from this plant.

Photo.-Mechl. Dept., Thomason College, Roorkee.

5 Furcræa gigantea (not poling) and F. gulengis (poling).



6 Revd. R. Winsor's fibre-extracting hand machine.

The principal commercial manufactured articles from agaves are matting, rope, and twine.

While the Forest Department could not of course take up the regular cultivation of "aloes," there is no reason why suitable black-cotton areas, of which we have enormous areas in some of our C. P. forests or boundary lines, should not be planted up either with the common grey C. P. agave, or with *A. sisalana* and also experimentally with *F. gigantea* and *C. gigantea* on the lines of the most successful experiment which was described in the letter which appeared in the September number. It can hardly any longer be termed as experiment since it has succeeded so well, and it has the added merit of extreme simplicity and cheapness. It should be the very thing for forest villagers, especially if they were offered a share in the profits, and it has many advantages over the cultivation of lac which is at the best precarious though lucrative when successful; whereas "aloe" cultivation should never or rarely fail and always prove lucrative.

Of course it must be within a reasonable distance of a railway, or freight must be carefully considered and added into the cost of production and extraction: and the better species should always be tried alongside with the indigenous varieties to determine whether the added value of the former outweighs the probable greater hardiness of the latter. It has in fact all the essentials of an industry, and one capable of development and establishment on a large scale.

"MORE LIGHT."

SOME REFLECTIONS ON READING A RECENT BURMA WORKING-PLAN.

BY "OP"

"In determining the method.........it must be specially noted that the increment alone renders the growing stock an active capital; hence it must be the forester's first care to bring the increment up to its normal amount."

In his manual on Forest Management, Sir W. Schlich lays down this principle for guidance as to the immediate steps to be taken for regulating the management of a forest in abnormal condition. Yet in the working-plans for the teak forests of Burma based on a method of calculating the yield, admittedly constructed only for temporary use, this principle has been relegated to a position of secondary importance, while "the maintenance of the yield" and "the proportionate representation of the age classes" have taken prior place. The formula put forward by Sir Dietrich Brandis for ascertaining the number of first class teak trees which might be removed annually was designed to prevent the deterioration of the forests, while extraction was not stopped and a speedy determination of the yield was effected But it will hardly be suggested that this formula was intended for permanent use: it was a temporary expedient, useful when the staff was so limited that accurate valuation of the growing stock was impossible. This difficulty is no longer present in the same degree. It is possible to ascertain the growing stock of a whole forest now and not to rely upon only the numbers of the maturer trees present for calculating the available increment of a whole forest.

The yield of a forest is the increment obtainable from the whole forest and not from a limited number of age classes. Brandis' method, as modified by the various safeguards in use, inevitably shows the presence of a so-called "surplus" growing stock, which is then taken as surplus and removed in a limited number of years.

Now, growing stock is surplus only when its increment is so low that it can profitably be replaced by more vigorous young trees, and *will be* so replaced. The weak point of the present system is that this productive growing stock is removed and adequate measures to replace it by trees producing an equal increment are not taken. The surplus growing stock, though long past the culmination, of its current annual increment, is still usefully productive, the C. A. I. for trees over 7 feet in girth being about ·466 of an inch in girth, while at its culmination when the tree is about 2 feet in girth the C. A. I. amounts to about ·667 of an inch in girth.

Taking the case of the plan under consideration, the growing stock was found to be as follows :—

Sound Teak 7 feet in girth and above		(Class I)	... 58,023
" "	6 to 7 feet in girth	(Class II)	.. 49,395
" "	4½ to 6 feet in girth	(Class III)	.. 87,917
" "	3 to 4½ feet in girth	(Class IV)	... 74,272
" "	1½ to 3 feet in girth (dominant)	(Class V)	... 67,935
		Total	.. 337,542

while the time taken for a second class tree to become a first class tree was found to be 30 years. Ninety seven per cent of the first class are assumed to survive to be girdled during the felling rotation of 20 years, 90 per cent of the second class, and 75 per cent of the third class.

The number of trees becoming mature during the 20-year period is then $\frac{20}{30}$ of $\frac{90}{100}$ of 49,395 or annually 1,482.

The normal growing stock of such mature trees is $\frac{1482 \times 20}{2} =$ 14,820 and the difference between this figure and the real growing stock of mature trees is considered surplus. This amounts to $\frac{97}{100}$ of 58,023—14,820 = 41,462 or for 20 years annually 2,073.

1,482 + 2,073 = 3,555 is then taken as the yield, but this is reduced by various safeguards to 3,000.

The rotation is fixed by the requirements of the European market, and a tree is felled only after attaining a girth of 7 feet. The volume is considered to vary directly with the girth. The consideration of the girth-increment is thus for Burma, in the absence of *volume statistics or yield tables*, the best substitute that can be suggested for volume-increment. In the case of the plan under consideration the Mean Annual Girth Increment was found to be ·465 of an inch. The total number of trees over 1½ feet in girth being 337,542, the girth-increment per annum of the forest (excluding trees under 1½ feet girth, is 337,542 × ·465 = 156,957 inches equivalent to 1,868 trees of 7 feet girth. Now, this is the true increment of the whole forest, not of only certain age-classes, and the removal of this number of mature trees can be justified. But the normal increment must be more than this. The forest should be managed at least to maintain the present real increment—that

is, any old stock removed must be replaced by trees freed from the suppressed fifth class, unless this has been first assured, the removal of any growing stock which leads to a diminution of the whole forest's increment is not justified. Thus, we may divide the possible yield into two parts, the first which may be removed because it is being naturally replaced—and the second part which may be removed only after such increment as it produces has been definitely secured for the future by the freedom from suppression of dominated fifth class trees. These two parts, the first and the second, are respectively the real increment and the so-called surplus. The conclusion to which this consideration forces us is that while the extraction of the first part may properly take place at any time, the second part may be removed only after improvement fellings have been made and by their thorough execution, have been found after inspection to ensure a proportionate replacement of the over mature but increment producing "surplus."

Turning from theory to fact we find that while the whole forest of 220 square miles is being exploited in a period of 20 years and 60,000 mature trees are being removed, improvement fellings are being carried out over a maximum of 20 square miles and a minimum of 10 square miles. The exiguous proportions of this work are excused by a reference to the labour market and to the difficulty of supervision. A comparison with the labour involved in extracting 60,000 trees in 20 years seems a sufficient answer to the question of labour supply. If the one is possible, so is the other; while difficulty of supervision is surely one of the very problems which it is the business of the Forest Department to solve, and can be nothing more than a matter of efficient organisation.

Instead of at least maintaining the real increment of the forest, the following growing stock is found after the first felling rotation :—

First Class	...	25,919	trees	
Second Class	...	47,788	„	
Third Class	...	70,106	„	
Fourth Class	...	52 535	„	
Fifth Class	...	30,000	„	(maximum)
	...	226,348		

The growing stock has been reduced from 337,542 trees to 226,348, and the Mean Annual Girth Increment of the forest from 156,957 inches to 105,252.

Great companies employing thousands of men and investing enormous sums of money are engaged in extracting the produce of these forests, while the real provision for a maintenance of the present real increment of the whole forest, let alone the establishment of the normal increment, is limited to improvement fellings carried out by the microscopic and generally untrained staff. Surely, the time has come for it to be realised that operations for the maintenance of the increment over the whole forest must be proportionate in their extent and intensity to the infinitely more thorough measures taken to ensure exploitation.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

IN THE HOUR OF DANGER.

One evening I was encamped at a spot where the River Jumna cuts through a range of hills called the Siwaliks, when information was brought in that a tiger had killed a bullock in rather a weird and unfrequented part of the jungle about two miles from my camp I immediately went out to ascertain the truth of the report and, if possible, to have a look at the kill, and found it lying in a *nullah* on one side of which was a sheer bank of about 20 feet high, and, as there was no tree anywhere suitable for a *machan*, I got a *charpoy* (native bed) and fixed it up with two legs on the top of the bank and the other two resting on a thick bush growing out of the steep bank of the *nullah*. The back legs of the *charpoy* were resting on a narrow path which ran along the top of the bank, whilst the front were directly overhanging the *nullah*, and, on account of the depth of the latter, I thought I should be fairly safe. Having seen everything rigged up to my satisfaction, I went to camp to fortify the inner man before returning to take up my position for the night.

My wife, who generally accompanies me on my tiger trips, came with me, and, having travelled as far as the base of a hill that ran along between my camp and the kill, on one of my elephants, we were soon on the spot and settled down on our somewhat rickety perch. It was now about five o'clock, and the evening promised to be fine and clear, but as the moon rose a

* *Vid* page 555 of the *Indian Forester*, Vol. XXXIV.

storm came on, and the thick black clouds that filled the sky left us in almost Egyptian darkness. It was a curious situation; the loneliness of the jungle, the feeling that a tiger was near at hand, the inky blackness of the sky, and the thunder roaring amongst the hills, made the night one of the weirdest in my experiences, and one which I shall never forget.

The *nullah* in which the kill was lying ran out of a horse-shoe ridge, and, although quite 20 feet deep where we were situated, it shallowed rapidly in the direction of the ridge, and about a dozen yards higher up it was no more than 3 feet or 4 feet. I was seated on the end of the *charpoy* overhanging the bush, and immediately above the kill, whilst my wife sat behind me on the end that was resting on the path, from which the ground sloped sharply up.

About nine o'clock I heard the tiger come up to the kill, crunching the stones under his feet and sniffing loudly as he walked along; this continued for some little time, and I warned my wife, by a nudge of my elbow, to keep quiet. For about ten minutes all was still and I could hear nothing, when suddenly we heard the tiger approaching by the path on which the *charpoy* was actually resting. He had, of course, winded us and began sniffing loudly again, and seemed to come so close that I felt I could have touched him with my rifle. He had evidently suspected something when he was down in the *nullah*, and had come up to reconnoitre, and having approached as near as possible, retired. As soon as I heard the tiger coming along the path I slewed round and rested my rifle on my wife's knees and, although the tiger must have come within a couple of yards of us, absolutely nothing could be seen, not even the luminous eyes that sportsmen mention, so intense was the darkness at the time, and under the circumstances I could not fire. There was another pause, and then the tiger was heard again, this time on the other side, sniffing as loudly at us and coming as unpleasantly close as before. However, he again retired, and nothing more was heard for some time Still unsatisfied, he made yet a third reconnaissance, this time more noisily by the slope in the rear of my wife, and stones displaced by his feet rolled down on to our *charpoy*. Again the snorting and

sniffing ceased, and all was quiet. My wife then asked me in a whisper whether I thought we were safe, as I was unable to fire. I said I thought the tiger, having winded us, was only sniffing round out of inquisitiveness No doubt he was very hungry and anxious to get at his kill, but, having discovered our presence, would not go to it.

I thought perhaps the moon would appear and enable me to get a shot, so we decided to sit tight. Shortly afterwards, however, the tigress, as she turned out to be, with two cubs, gave vent to a series of roars just above us, and certainly within fifteen yards. My wife did not like the situation at all. There we were, face to face with a tigress roaring with rage at not being able to get at her prey. One spring, and she could have been on us, and it was too dark to fire. We were, in fact, absolutely helpless, so I took the ball cartridges out of the smooth bore I was using and popped in a couple of shot cartridges, which I fired in the air with the hope of scaring the tigress, who was still roaring furiously; we were, in fact, trying to bluff one another. The effect was instantaneous, for the roaring immediately ceased, so I lighted a hurricane lantern I had with me, and, having reloaded with shot cartridges we commenced our retirement. We walked along the edge of the *nullah* to a spot where it was shallow enough to get down, and were no sooner there when I heard distinctly a stealthy tread behind me, so I promptly fired off a couple more shots in quick succession.

We were now really in a very dangerous situation—between the devil and the deep sea—as we were down in the *nullah* between the tigress and her kill. However, having gained the opposite bank, I hauled my wife up and put her in front, whilst I followed, holding the lantern behind me so as to expose the light in the probable direction of attack, for there was little doubt the tigress was coming up behind. In this way, with many a backward glance, we reached the watershed of the range in safety, and descended to the foot of the hill. We found our elephant waiting for us, after having had about as unpleasant an hour as I ever remember in all my experience.

Early next morning I went back to inspect the ground which had been the dark theatre of our adventures, and found that the kill had been entirely devoured during the night and, by the pug marks, discovered we had been visited by a large tigress and two fair-sized cubs. This accounted for the persistency with which she attempted and finally succeeded in getting rid of us. From the appearance of the remains of the carcase the next morning, it was evident the happy family were not long in getting to work as soon as all was reported clear for action. So they got their dinner after all, and probably without ever appreciating the kindness of the moon in playing the part of the ideal chaperon.—(*By E. A. Down in the Field*.)

ASIATIC HORNS AND ANTLERS.*

This is an illustrated catalogue of the Asiatic horns and antlers in the collection of the Indian Museum, at Calcutta, by T. Bentham. The object of publishing this catalogue is stated to have been two-fold. In the first place it was believed it would be useful to sportsmen who frequently write to the Museum for information about horns and antlers, and in the second it was intended to serve as an appeal to those who are in a position to help the Museum by making donations of specimens. The measurements are all given in inches and decimals The nomenclature follows the late Dr. W T. Blanford's volume on Mammalia in the "Fauna of British India and Ceylon."

We give below a statement showing the longest specimens in the Indian Museum of horns and antlers of each Indian species, in the hope that those who can spare better ones will present them to the Museum. For convenience of reference the record head of each species is also noted. It will be observed that of six species, the Indian Museum owns the record.

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* Published by order of the Trustees and sold by the Superintendent, Indian Museum, Calcutta. Price 2 rupees.

Scientific name	Common name.	Longest specimen in Indian Museum, in inches.	Record length, in inches.	REMARKS.
Bos gaurus ..	Bison or Gaur ..	31·5	46	
,, frontalis ..	Gayal or Mithan ...	18·25	18·25	Record
,, sondaicus .	Banting	31	31	Record.
,, grunniens .	Yak	33·4	39	
,, bubalus ...	Indian Buffalo .	53·75	77·375	
Ovis hodgsoni ...	Great Tibetan Sheep or 'Ovis Ammon.'	43·5	57	
,, poli	Marco Polo's Sheep ..	68	75	
,, vignei ...	Urial or Shapoo ..	31	39·5	
,, nahura	Bharal ...	32	32·5	
Capra ægagrus ...	Persian Ibex ...	43·3	53	
,, sibirica ..	Kashmir Ibex .	46·5	57·4	
,, falconeri ...	Markhor	45	63	
Hemitragus jemlaicus ..	Tahr ...	13	15·5	
,, hylocrius ..	Nilgiri Wildgoat ..	15·75	17·5	
Nemorhædus bubalina	Serow .	9·5	13·5	
,, goral .	Goral . ..	7	8·5	
,, sumatrensis	Kambing Utan .	9·5	9·5	Record.
Budorcas taxicolor	Takin . .	24·5	24·5	Record.
Boselaphus tragocamelus	Nilgai ..	8·75	11·75	
Tetracerus quadricornis,	Four-horned Antelope	3·8	5	Back horns.*
Antilope cervicapra .	Blackbuck ...	36	40·5	(Round curve, the record measured straight is 28·25.)
Pantholops hodgsoni ..	Chiru .. .	26·3	27·75	
Gazella subgutturosa ...	Persian Gazelle ...	16	16	Record.
,, picticaudata	Thibetan ,, .	13·3	14·75	
,, bennetti	Indian ,, ..	12	15	
Cervus cashmirianus ..	Kashmir Stag ...	41	48·5	
,, affinis ..	Shou	41·25	55·75	
,, aristotelis	Sambar . ..	43	50·12	
,, axis .	Chital or Spotted-deer	34·75	38·75	
,, porcinus ..	Hog-deer .	20·5	23·25	
,, eldi ..	Thamin ...	33·75	42	
,, duvauceli .	Swamp-deer ..	35·5	41	
Cervulus muntjac .	Barking-deer ..	8·25	8·25	Record.

* The head with the best developed front horns in the Indian Museum has back horns 3·25, front horns 1·75 inches.

EXTRACTS FROM OFFICIAL PAPERS.

MEMORANDUM REGARDING PRESCRIPTIONS FOR IMPROVEMENT FELLINGS IN TEAK WORKING-PLANS IN BURMA, AND THE INTRODUCTION OF A MORE UNIFORM SYSTEM OF WORKING.

A subject which presents a great deal of difficulty in the proper management of the teak forests of Burma is the manner in which improvement fellings—which we may here take to include climber-cutting—should be carried out

2. In the great majority of existing working-plans the lines adopted are to prescribe improvement-fellings over large areas, frequently in the areas to be girdled over annually. A perusal of annual reports, however, shows how impossible the task is to execute these fellings over anything like the area desirable, for it must be admitted that the girdling of teak without a corresponding diminution of the proportion of inferior species is likely in time to deplete seriously the percentage of teak which ought to be present.

3. In small areas, for example the Kangyi Working Circle of the Zigon Division, the Working-plan Officer has had no hesitation in prescribing periodically recurring improvement-fellings at fairly short intervals, but in the vast areas which constitute the majority of the working circles in Burma the magnitude of the operations entailed has deterred the Working-plans Officers from prescribing improvement-fellings of the intensity desirable.

4. It is well known that the most critical times in the life of a teak tree are the periods during which the seedling is endeavouring to establish itself, and during which it is struggling against bamboos and inferior species in the sapling and young pole stages. The cutting back of bamboos over young teak is an operation which, to be of any lasting use, should be carried out not once, but generally

at least twice and sometimes oftener, at intervals of about 6—8 years on an average. Climber-cutting, likewise, should be repeated at similar intervals, and not carried out once only, whilst great advantage would be gained from constant cleaning of undergrowth endangering the existence of young teak.

5. A consideration of these facts leads us to enquire whether time and money would not be better spent in carrying out improvement-fellings at short intervals over concentrated areas, than in attempting them in a cursory fashion over large areas. In this way attention would be given more fully, than is at present the case, to saplings and young poles, as well as to larger trees.

6. In connection with this it is necessary to allude briefly to another subject, namely, the introduction, in place of the existing selection system for working teak, of some more uniform and systematic method. The selection system, although perhaps the only one applicable as a temporary means of working the large tracts of teak forest in Burma, can hardly be regarded as an ideal one, as it involves working over large areas for one species only, it prelcudes any serious attempt at ensuring natural reproduction, it prevents the working out of many kinds of timber which it would pay to extract if the fellings were concentrated, and it renders girdling of trees and supervision of fellings much more difficult than if this work were carried out over small areas of more or less even-aged forest.

7. The subject of introducing an uniform system has been mentioned here because the two operations (1) conduct of improvement-fellings over concentrated areas, and (2) measures for obtaining and assisting reproduction with a view to producing even-aged crops, must go hand in hand. In this connection, reference is invited to the article entitled "Fire Conservancy in Burma" in the *Indian Forester* of December 1907, by Mr. F. Beadon Bryant, the Chief Conservator of Forests in Burma. On page 548, the author, referring particularly to the "moist mixed" type of teak forest and to forests of an evergreen nature where, with the aid of fire-protection, evergreen is encroaching on the teak, writes as follows :

"The only way to realise the undoubted benefits arising from fire-protection and to maintain the teak in these forests, is to change the method of treatment. The teak, being a light-demanding tree which cannot establish itself under the shade of the bamboos and of the species with heavy cover with which it is associated, is not adapted to treatment by the selection method combined with fire conservancy. The flourishing *taungya* plantations of even-aged teak poles, some of them now some 40 years of age, show us that it is quite possible to grow even-aged crops of teak, and though it is not possible at present to say whether this plantation teak will at maturity yield such valuable timber as can be obtained from the natural forests hitherto overrun by fire, there is reason to hope that it will do so. Whilst abandoning fire conservancy in this class of forest, I would therefore endeavour to aim at establishing young growth over a certain proportion of each working circle or forest unit, by concentrating on it plantations, improvement-fellings and other measures, such as sowings and dibblings undertaken in order to induce reproduction. So soon as satisfactory young growth has been obtained over the area thus set aside for regeneration, fire-protection should again be enforced, and when the time comes for revising existing working-plans or framing new ones, the possiblity of treating the forest by the regular method should be fully considered."

8. It remains now to suggest how the measures referred to above might be carried out in practice In every existing teak working-plan in Burma, with only four exceptions, the calculated rotation of teak varies within the narrow margins of 150 to 180 years. In introducing an uniform system, one of the first points to be decided on by the Working-plans Officer is what the regeneration period should be. This he can do without difficulty, by finding the rate of growth of young trees in the locality in which he is working and deducing the period required for a seedling to (1) establish itself (this is generally assumed to be 10 years), and (2) grow up out of the reach of bamboos or other growth. Let us assume, for the sake of an example, that this whole period is 25 years, and that the rotation is fixed at 150 years. This gives us six periods

of 25 years each. Now, if the area of the working circle be 120 square miles, it means that 20 square miles have to be regenerated and the young trees brought up out of the reach of bamboos during the 25 years' period. The periodic block (20 square miles) should be gone over, let us say, at intervals of 8 years, that is, three times during the period, with one year to spare. This means that $20 \times 3 = 60$ square miles have to be worked over during 24 years, giving an averge annual area of $60 \div 24 = 2\frac{1}{2}$ square miles. This assumes that the whole periodic block is teak-bearing or capable of producing teak and accessible : but such is not always the case in actual practice, when the annual area operated over would be smaller.

9. The work to be done in this periodic block during the period would be—

(1) Girdling and extraction of teak for the market.

(2) Felling and extraction of other timber for the market.

(3) Improvement fellings, including climber-cutting and cleanings of bamboos, etc., over young teak, *pyinkado* and other valuable species, repeated every eight years or oftener, the annual area operated over being $2\frac{1}{2}$ square miles in the case of operations of 8 years' interval.

(4) Aiding reproduction by all possible methods which experience and further experiment may suggest, such as the following :

(*a*) Dibbling seed in blanks.

(*b*) Wounding the soil and sowing.

(*c*) Planting.

(*d*) Concentrating the grazing of elephants in bamboo areas.

(*e*) Burning where necessary and for such periods as may be found necessary.

10. It is believed that by concentrating operations and repeating the improvement-fellings, climber-cutting and cleanings, every 8 years as suggested, reproduction should spring up far more freely than is the case under existing conditions. In other periodic blocks nothing whatever should be done to stimulate

new production by cleanings or any other operations, as reproduction is not yet required there, and plantations should be rigidly confined to the periodic block under reproduction.

11. As regards girdling of teak and felling of other species, theoretically everything should be removed, which is not in the sapling and young pole stage, before the end of the period. In the case of inferior species, no doubt everything of pole size and upwards would be removed where they interfere with young teak. In converting from one system to another some temporary sacrifice is almost inevitable. In this case the sacrifice would have to consist in girdling undersized teak: the ultimate benefit, as far as density and uniformity of the new crop are concerned, would, however, far outweigh this temporary sacrifice. It is not suggested that all small teak trees should be girdled, but that the girdling limit in the periodic block under reproduction should be lowered. Probably it would be advisable to remove all trees of the 3rd class and over so far as these are marketable.

12. Work in other periodic blocks would consist of the following operations :—

(1) Girdling and extraction of mature teak under the selection system.

(2) Felling and extraction of mature trees of other kinds under the selection system, if feasible; such work in the block under regeneration, however, to receive first consideration.

(3) Improvement-fellings, as indicated in paragraph 13 below, *only in so far as they can* be carried out without detriment to the work in the block under regeneration, which should always have first consideration.

13. To continue our concrete example, we may assume the various periodic blocks are to be taken up for regeneration in the periods of years given below: then improvement-fellings, if they can be carried out, should, during the 1st period (1911—1935), be made with special reference to the teak trees of ages mentioned in the 5th column of the statement below, the approximate girth

classes corresponding, being determined by the Working-plans Officer during his examination of the area.

Period No.	When regeneration is to be undertaken.	AGE OF TREES EVENTUALLY REQUIRED FOR FINAL CROP.		
		At beginning of 1st period. (*Years.*)	At end of 1st period. (*Years.*)	Limits of age of trees which should receive special attention during improvement *fellings* and other particulars.
1	2	3	4	5
I.	1911—1935...	125—150 ...	Old trees all felled. Young growth 0—25	(Improvement-fellings, etc., as detailed in paragraphs 9 and 10 above.)
II.	1936—1960...	100—125 ..	125—150 ...	*Nil.*
III.	1961—1985...	75—100 ...	100—125 ..	*Nil.*
IV.	1986—2010...	50—75 ...	75—100 ...	50—100 years, if conditions of staff, labour, etc., will allow it.
V.	2011—2035...	25—50 ...	50—75 ...	25—75 years, if conditions of staff, labour, etc., will allow it.
VI.	2036—2060...	0—25 ...	25—50 ...	0—50 years. This is next in importance to improvement-fellings in period I: the operation will consist of freeing saplings and poles of teak and other valuable species.

14. To recapitulate, improvement-fellings should, it is suggested be carried out thoroughly in the periodic block under regeneration: if they can in addition be carried out in other blocks, then they need only be carried out with reference to the trees of ages mentioned in column 5 of the statement in paragraph 13 above.

15. There is one other point of importance, namely, the arrangement of teak girdlings and fellings of other trees in the

block under regeneration. Should these be carried out once only, so as to remove the whole mature crop at once, or should they be done gradually, the area being gone over two or three times during the period? There is no doubt something to be said for either plan, but future experience will probably be the best guide: local conditions, such as danger from weeds, may also influence the question. It is true that drastic openings often result in a good crop of teak reproduction, and certainly where advance growth is abundant and weeds are not too luxuriant, the overwood might be cleared away early in the period. Otherwise, it would appear advisable to leave a good many teak seed-bearers till near the close of the period, or until reproduction is well established, the canopy having been well opened out early in the period by the removal of other species, and teak where necessary. In this connection, a good deal of latitude might be left to the Divisional Officer until more experience is gained. In any case all the larger trees should, it is considered, be removed by the end of the period, any large blanks having been planted up some years before the period closes.

16. We may here refer to the Preliminary Working-plan Report for the Mohnyin Reserve, Katha Division, Upper Burma, drawn up in 1907 by the Chief Conservator of Forests in Burma, and approved by the Inspector General of Forests. This reserve has hitherto been worked under the selection system under a working-plan containing prescriptions for the 15 years 1895-96 to 1909-10. This forest, owing to girdlings which are described as unnecessarily cautious, still contains a large number of large over-mature and deteriorating teak trees, while natural reproduction, under the selection system of working, has not come up to anything like the extent desirable, although teak seed-bearers are plentiful. Experiments carried out by the late Mr. Messer, and continued by his successor Mr. McHarg, have proved that by gradually removing the overhead cover and by clearing away the undergrowth by fire or by clearing and sweeping, excellent natural reproduction can be obtained, and that the seedlings, if weeded for two or three rainy seasons, will develop into strong healthy plants. This operation is virtually nothing but a seeding felling, and basing his conclu-

sions on the results of the experiments referred to, the Chief Conservator drew up a preliminary working-plan report for treating the forest under the Uniform Method. For this purpose a regeneration period of 20 years has been proposed, the number of periods in the rotation depending on the exploitable age, which will be determined by the Working-plans Officer. These proposals are given in detail in Inspector-General of Forests' Proceedings of January 1908, Working-plans A, Proceedings Nos. 7 to 9, to which reference is invited.

17. To continue the general consideration of this question, schemes of cleaning and thinning and plantations would have to be drawn up separately, such operations being carried on as required after the regeneration period closes. The same would apply to natural crops of young teak, after the regeneration period closes: this, however, need not trouble us at present, as the Working-plans Officer would deal in detail only with prescriptions affecting the first period.

18. The measures advocated in this memorandum would, it is thought, solve to some extent the vexed question of fire-protection, in that burning could be carried out to stimulate reproduction, and that fire-protection could, if necessary, be introduced later when the young teak has outgrown bamboos and other weeds. The following quotation from the Preliminary Working-plan Report for the Mohnyin Reserve, alluded to in paragraph 16 above, is of much interest.—"Fire-protection will be continued, but the use of fire in clearing the regeneration areas will be taken full advantage of. It is, moreover, considered advisable to try the effects of firing the forest over which selection and improvement fellings will be undertaken. The effect of fire-protection during the last 10 years is very unsatisfactory. It is, therefore, proposed to burn one of the periodic blocks for a series of years commencing two years before girdling is undertaken in it. Should satisfactory reproduction be obtained, fire-protection will again be applied, and the treatment applied to other blocks."

19. It is possible that the proposals contained in this memorandum may be objected to on the ground that the staff and labour

is insufficient to carry out improvement-fellings and cleanings with the intensity required. The answer to this, however, is that by concentrating operations as suggested there will be a great saving of labour and staff, while in the more accessible localities much of the work will be done by timber traders, who will work out inferior species more readily if they can fell a quantity of timber over a small area than if they have to fell and extract trees scattered over large areas. Considering these points, there can be little doubt that with a given staff and a given quantity of labour a great deal more work will be done in concentrated blocks than in large and scattered areas, such as are worked over at present.

20. As regards the actual area to be gone over per annum in a block under regeneration, the example given above may be taken as a fairly typical one, and we have seen (paragraph 8) that for every 120 square miles of working-circle area, we should have to operate over 2½ square miles or roughly 2 square miles per 100 square miles of working-circle area. Now, this includes forest which is not teak-productive and which is inaccessible so that, as a general average, we may assume that for every 100 square miles of reserved forest in a Division, the area to be worked over, as far as regeneration operations are concerned, is considerably less than 2 square miles per annum. In addition we have *optional* improvement-fellings, to be carried out as far as staff and labour will permit, in areas not under regeneration (*vide* paragraph 13 above), but these apply only to teak trees of certain age classes, and not to trees of all sizes, as is required under the selection system.

21. To summarise, the above proposals contemplate the conversion of the present irregularly stocked teak forests, worked by a rough selection method, into more or less even-aged forests worked under a uniform system more suited to a light-demanding species like teak, and to the conditions of staff and labour which obtain in Burma.

22. It is not proposed that these suggestions should be accepted without full discussion, or without being applied tentatively

in actual practice. If the proposals are accepted in the main, there are various details to be discussed, for example the following:—

(1) Could the proposals be introduced without unnecessary complication in existing working-plans? It is believed they could in many cases, at any rate in working-plans which have not been long in operation.

(2) How far should burning be carried out to assist natural reproduction? This is perhaps a subject for experiment rather than for discussion, though a discussion as to the form of experiments to carry out would be useful.

(3) Could some system not be devised to facilitate the actual carrying out of improvement-fellings? It is believed that several parties working independently, each under a "gaung" or head, the whole being under the supervision of a responsible officer, would get over a large amount of ground. Men who are intelligent enough to act as demarcators and enumerators on working-plans should be capable, after a short training, of carrying out improvement-fellings, the execution of which is not a very difficult operation.

(4) To what extent could bamboo extraction be confined to blocks under regeneration? This is an important matter, as the concentration of bamboo extraction would go far towards freeing teak seedlings and saplings without any expenditure.

These and many other points, regarding which Forest Officers might offer suggestions, could form the subject of much useful discussion in a matter which is of great importance to the future of the teak forests of Burma. As a result of such discussion it should be possible to draw up a regular scheme for the guidance of Working-plans Officers.

R. S. TROUP,

Imperial Superintendent of Forest Working-Plans.

Dated 21*st July* 1909.

Photo-Mechl. Dept., Thomason College Roorkee.

I

Photos. by Shrinivasalu Nayadu.

II

Cultivation of *Acacia arabica* (Babul) in Berar.

(For description of photographs see page 305).

VOLUME XXXV NUMBER 11

INDIAN FORESTER

NOVEMBER, 1909.

STANDARDISATION OF TREE MEASUREMENTS.

There is a considerable amount of confusion in the matter of the measurement of trees in India and Burma, and it is a matter for regret that definite rules on the subject were not formulated when the Forest Department was started. We wish to draw attention to this most important subject in the hope that definite rules will be drawn up and adopted generally for the future.

In the first place, there are two systems ordinarily in vogue for the classification of trees; one by girth classes and the other by diameter classes. For the former, classes of 18 inch periods are usually adopted and for the latter, classes of 6 inch periods. Thus for girth classes it is usual to speak of trees measuring less than 1½ feet in girth at breast height as V class trees, those above 1½ feet and up to 3 feet as IV class; those above 3 feet and up to 4½ feet as III class; those above 4½ feet and up to 6 feet as II class, and those above 6 feet in girth as I class. It is equally common, when reference is made to trees classified by diameter measurements, to speak of trees up to 6 inches in diameter at breast height as V class trees, trees above 6 inches and up to

1 foot in diameter as IV class, trees above 1 foot and up to $1\frac{1}{2}$ feet as III class, trees above $1\frac{1}{2}$ feet and up to 2 feet in diameter as II class, and trees above 2 feet in diameter as I class.

It thus comes about that I class trees are loosely referred to as being either above 6 feet in girth or above 2 feet in diameter, as if these measurements were synonymous. An instance in point occurred a few years ago in an important working-plan. The enumerations were done with callipers graduated for 6 inch diameter classes, and the results obtained were treated as girth classes and the prescriptions made accordingly. Owing to this, trees in the first coupe above 6 feet in girth which were found available for felling were 2,000 more than the number expected, for the change from diameter to girth classes really brought more than one sixth of the trees shown in the enumerations as II class according to diameters into the I class according to girths, *i.e.*, above 6 feet in girth.

Again, the classes mentioned above have practically become, throughout India, standard classes of measurement, it only remains for it to be decided whether girth classes or diameter classes are to be adopted for the future. Thus, almost all forest officers, if asked what a I class tree was, would say it was a tree measuring over 6 feet in girth or over 2 feet in diameter; some would say the one, some the other, and some, speaking loosely, would speak of the two as synonymous. Thus, a I class tree is practically a standard size, differing only within the above limits. This being so, it is very confusing to find that in some cases trees of other sizes are called I class, and so on. For an instance we refer to page 571 of the October number, where the classes adopted are quite different. Any one after reading the article on this page would, on turning to page 588 of the same number, be puzzled to know what is meant by a III class tree in the last sentence of para. 11.

It is therefore, we consider, most advisable that definite standard classes should be fixed so that it will always be known what is meant by a I class tree, II class, and so on. In our opinion girth classes are the most suitable, for the sections of trees are seldom circular and it is a matter of some difficulty to ascertain the

exact average diameter of a tree, whereas the exact girth can always be easily ascertained. By this we do not mean that all measurements of trees for marking, etc., should be done by tape. It is easy to have callipers graduated to correspond to the diameters of the 18 inch girth classes, and it is usual in practice when using callipers to measure each tree in two directions at right angles. We have found it quite accurate, if it is found that a tree, measured in both directions, falls to the same class, to record it as belonging to that class, but when the measurement in one direction locates a tree in one class, the measurement in the other in another class, we found the simplest way to decide the right class was by girth measurement with a tape. We recommend that the girth classes given above be now officially adopted as standard classes, so that in future there will no doubt as to what is meant by a I class tree, II class, and so on, and as these classes are already generally known and used, it would be simpler to adopt them than to lay down a revised scale of classes altogether.

Of course we recognise the fact that for many working-plans and other purposes, the standard classes would not be sufficient, as it is often necessary to discriminate between the sizes of trees above 6 feet in girth and to differentiate in more detail between smaller trees. For the latter, subdivisions of the standard classes will generally suffice, but for all other divisions from the standard classes we recommend the adoption of letters to indicate that the class referred to is a special one. Thus, in cases where a minimum exploitable size of above $7\frac{1}{2}$ girth is adopted, the class above $7\frac{1}{2}$ feet in girth might conveniently be termed M. class, meaning mature, or by any other appropriate letter. Any officer coming across the mention of an M class tree for the first time, would at once enquire what it meant and no confusion would arise.

The question as to the height at which the girth measurements should be taken is more complicated, for on account of some species developing large buttresses, they cannot be measured at the usual breast height which is generally taken to be $4\frac{1}{2}$ feet above the ground. For practical purposes it will probably be sufficient for the girths to be taken as they are now at breast height where there

are no buttresses, and as near above that as the buttresses will allow, if there are buttresses, except when the buttressed portion is utilized, in which case a correcting factor might possibly be adopted. This matter is one on which some enquiry is necessary before standard rules can be decided on.

At present in India, so far as we are aware, there are no height classes in general use, and it may be argued that as there are so many different species to be dealt with it would not be of much use to have standard height classes laid down. We, however, are of opinion that it would be most advantageous and we suggest that a suitable standard scale of height classes be drawn up and prescribed officially at the same time as that for girth classes. Height is the most reliable indicator as to quality of soil, and once the standard height classes were adopted, it would in time lead to the classification of soils by the height class attained by important species at different ages.

We trust that this important matter will now receive the attention it deserves and, if standard classes are adopted, we recommend that the details concerning them be included in the revised edition of the "Glossary of Technical Terms for use in Indian Forestry". It might even be possible to include, from time to time, any special classes indicated by letters, as proposed above in the glossary by means of addenda slips, indicating the area in which the special classes are in force. In this way all confusion would disappear and in a few years the standard girth and height classes would be definitely known and adopted throughout the Indian Empire.

SCIENTIFIC PAPERS.

THE EFFECTS OF CATTLE-GRAZING IN BHANDARA DIVISION, C. P.

Since the earliest times, when forests were managed with the view to game preservation, to the present money-making era when forests are managed sylviculturally, with the view to the best

financial results possible, the grazing question has always been a matter for discussion and legislation. In England, as a survival of ancient laws, sheep are not "beasts of common" in the eyes of the law, and can therefore have no right over common or waste land which other animals may enjoy, disabilities which the animal owes to the fact that deer will not feed over land pastured by it.

In the Central Provinces, where forest administration and protection is comparatively recent, and is carried out with a direct financial object and the supply of timber and other forest produce, grazing is only allowed as a privilege, and as a general rule the grazing of goats in reserved forests is prohibited.

It is only within the last 15 years since fellings have been restricted to defined areas, that the privilege of grazing cattle within our forests has been limited to localities where they can do least harm. There are, however, areas in the Bhandara Division where protection from grazing has been carried out for a sufficient number of years in succession, to afford data for a discussion on the subject of the effects of excessive grazing or successful protection from grazing upon the general condition of the forest and soil.

The Bhandara forests are of the ordinary Central Provinces type, the following species being prevalent :—*Terminalia tomentosa, Lebidieropsis orbicularis, Diospyros Melanoxylon, Anogeissus latifolia, Bassia latifolia, Buchanania latifolia, Soymida febrifuga, Butea frondosa, Pterocarpus Marsupium, Lagerstrœmia parviflora.* Bamboos and a few teak are found on rising ground and along the banks of nallas.

The forests which cattle frequent are on flat ground, with either a sandy loam or a black-cotton soil. The underlying rock is either gneiss or laterite. The rainfall averages about 50 inches. Otherwise the climate is the same as elsewhere in the Central Provinces, but frosts are uncommon and have little influence on the forest growth.

The observations on which this paper is based are made from (*a*) forests in which no fellings of green wood have been allowed for 16 years, but in which grazing has been permitted, (*b*) forests in which improvement fellings in high forest of the nature of

cleanings have been made but in which no grazing has been allowed for the last 11 years, and (*c*) forests worked under coppice with standards open ordinarily to grazing but closed for 10 years after fellings have been carried out.

The typical over-grazed forest, in which no restrictions to the pasture of horned cattle are prescribed, shows a great tendency to become patchy and the most promising regeneration is usually found in thick groups of poles and saplings, protected either by thorny growth which the cattle avoid, or by inferior growth on the outside of the groups, which helps to prevent the cattle from reaching the young trees within and so damaging the leading shoots or trampling down seedlings. Often regeneration is found in the group formation sheltered by some old mohwa or other large trees. In this case the localised regeneration has little to do with protection from cattle; it is more probably caused by the protection from atmospheric influences afforded by the shade of the tree, or possibly by the annual disturbance of the soil by the sweeping up or collection of the mohwa flowers.

Another phenomenon due to excessive grazing is the curious growth of young *saj* trees. I have in many places seen considerable areas of forest, the soil of which is completely covered by young *saj* trees up to 18 inches in height, very much branched and stunted in growth. On being dug up these plants will be found to have a thick and distorted stem at or just beneath the surface of the ground. It is possible to ascribe this condition of growth solely to forest fires.

I think that excessive grazing has more to do with it however because the phenomenon is as common inside forests which have been successfully protected from fire for a number of years as it is in forest where protection has not been attempted, and one would expect these young trees to recover after protection from fire for a number of years. Our best forests in Bhandara are always protected from fire, but, with the exception of the small area taken up by the high forest working circle in Gaikhuri Range, none of our forests are protected against cattle-grazing for a greater period than 10 years.

In the high forest circle, where protection from cattle has been carried out for the last 11 years, this condition of the *saj* regeneration although present is not common; it must, however, be borne in mind that previous to protection the ground was probably grazed as heavily as elsewhere.

In places such as steep hills where, owing to their inaccessibility, cattle never graze, stunted growth of young *saj* is absent and incidentally the regeneration of all species is in a considerably more satisfactory condition than in the level forests.

The cause of this abnormal growth of *saj* can be ascribed not so much to the browsing of animals as to their continuous trampling. This would account for the thick stem at the surface of the ground. If stems are continually, year after year, beaten down and mutilated, they could not be expected to send out a strong leading shoot, more particularly as the soil over the roots becomes hard through continuous trampling.

On the sides of steep hills where cattle seldom if ever graze there are usually a sufficient number of stones to prevent the trampling down of the seedlings as well as of the soil, hence the comparatively good regeneration on the hillsides.

I have observed a similar condition of growth of *teak* in the heavily grazed Salai block of the Partabgarh Range, but to a less extent. The difference being that the scattered *teak* seedlings are mostly affected, but subsequently recover, owing to their power of sending up a strong vigorous leading shoot from an old root, the strong side shoots remain for a number of years and then under favourable conditions subsequently die off. Where the regeneration is thick, however, trampling has not taken place, due no doubt to the immunity of teak foliage from browsing.

A similar stunted growth of *tendu* is often seen in very heavily grazed malguzari forest near villages, the stunted seedlings being thick and close together as in the case of *saj* and due no doubt to the same causes.

Continual overgrazing has a marked influence not only upon the distribution and growth of trees already discussed, but also upon the prevalent species found in the forest. It is natural that

after a number of years of heavy grazing, those species which cattle prefer to eat would diminish in numbers, and those favoured species, the leaves and shoots of which are not liked by cattle, should after a time predominate.

Consequently the *Gardeniæ*, *Zizyphus Œnoplia*, *Butea frondosa* and teak are particularly favoured in a negative manner by the grazing of cattle, and one or more of these species are usually found in marked evidence where heavy cattle grazing has been allowed for a number of years.

With the closure of the area to grazing and the improvement of the forest growth due to fire-protection, the *Gardeniæ* disappear, but in any case their presence in the forest is not a serious drawback, as they form a suitable soil covering and do not grow high enough to hamper the growth of other species once established.

Zizyphus Œnoplia, so far as weeds are concerned, is the greatest pest in Bhandara Division. Dense masses of this weed are found wherever extensive grazing has taken place, and owing to the thorny nature of the climber the forest is rendered in many cases impenetrable to man and beast. Groups of this weed sometimes form a nucleus for a group of regeneration of useful species, by the protection it affords through its thorns against cattle, but more often it prevents the healthy growth of more valuable trees by an extension into their crowns. It is a pest to any forest in which it is found and is a great hindrance to wood-cutters, who do not like to deal with trees surrounded by dense masses of climbers armed with hook-shaped thorns.

The permanent suppression of this pest will be a task of great difficulty. I have observed in Matora Working Circle that three years after complete coppice fellings have been made the *Zizyphus* thorns have got above the young coppice growth. It will be interesting to observe whether the complete protection from cattle-grazing will give the other and valuable species sufficient opportunity to suppress these thorns. Sufficient data are not as yet available. Certainly *Zizyphus Œnoplia* is less common in areas in which protection from cattle has been carried out for

a number of years. It is unfortunate that we have no information regarding the previous state of any particular area which is now free from *Zizyphus* before protection.

With the introduction of forest journals with entries for each compartment, we should be able to obtain information of this nature in the future.

In the high forest circle in which protection against cattle has been carried out for years, and where there is a good healthy growth, *Zizyphus Œnoplia* is not present to any appreciable extent. The pest is also not found on hilly ground where cattle go very little to graze.

In the coppice working circles, however, where closure against grazing is only extended over ten years after fellings, it is a question, considering the manner in which the *Zizyphus* climber gets above the coppice shoots after three or four years, whether it would be possible to get rid of all traces of the pest by sylvicultural treatment before the area would again be open to grazing. Probably if the coppice were comparatively free from the pest for ten years, the dense growth arising from the coppice shoots would be capable of keeping the thorns down.

Butea frondosa is another species not eaten by cattle and therefore favoured in the struggle for existence in heavily grazed areas. The species is valuable for its lac-producing properties and its roots. It occurs pure, on black-cotton soil, in heavily grazed areas near the villages. There are few trees that thrive on the black-cotton soil, and lac cultivation with unlimited grazing would appear to be the correct treatment for such places.

It is not usual to find *Butea frondosa* pure in grazed areas, except where black cotton soil occurs, otherwise the species merely shows a greater frequency of occurrence in grazed areas than elsewhere.

The most important species favoured by grazing is teak, and if it were not for the aversion of cattle to browse on this species, there can be no doubt that teak in the Central Provinces would be a comparatively rare species. The frequent occurrence of teak trees in grazed malguzari areas, adjoining protected Government

forests with a similar soil, etc., where they are not so common or where the regeneration is not so good can be ascribed to this cause. Cattle-grazing in Bhandara Division is actually favourable to teak regeneration, because it protects the young seedlings from suppression by other species. It is true, as already remarked, that the seedlings are at first trampled down, but owing to their capacity of sending out a strong leading shoot, the young teak survive the rough treatment. The best regeneration of teak in Bhandara Division is found in the two most heavily grazed areas, namely, the Margali Circle of Bawanthari Range and the Salai grazing block of the Partabgarh Range.

The height-growth of teak in these conditions is not satisfactory. As there are not, however, sufficient examples from which any definite conclusion can be drawn, statements of this nature must be made with caution, but certainly there are no teak of a good height and girth growth in the heavily grazed areas of the Bhandara Division

An interesting condition in connection with the heavily grazed Margali Circle in Bawanthari Range is that the southern portion, where there are few teak, is so heavily grazed that there is practically nothing to burn in the hot weather; the northern portion thus benefit by cattle-grazing not only through the favouring of its most valuable species but also by the natural fire-protection afforded by the heavy grazing to the south. Similar conditions are, I believe, found in the Arvi and Khondali ranges of the Nagpur-Wardha Division

The following description of the growth in a typically over-grazed forest, compared with that of a forest successfully protected for a number of years in Bhandara Division, extracted from my Forest Journal, will be of interest :—

MARGALI BLOCK, BAWANTHARI RANGE (OPEN TO GRAZING).

"The geological formation is mica schist and the soil is a sandy loam of suitable depth for tree growth. The soil covering is scanty forest growth and *Gardeniæ*, or a thin layer of fine grass over ground not shaded by trees. The growing stock includes the

following species:—*Saj*, *tendu*, *garari*, *lendia*, *khair*, *achar*, *mahua*, *rohan*, a few *bijasal* and also teak *Palas* is found throughout, but where black-cotton soil occurs it is found pure. Height-growth is poor. The actual stocking is about 0·4 compared with a fully stocked wood with a complete leaf canopy. The trees are usually grouped together and are not scattered evenly over the ground. *Zizyphus Œnoplia* is very common and renders the forest impenetrable in many places. Regeneration is poor with the exception of teak which is satisfactory. Regeneration of *bijasal* is practically absent."

HIGH FOREST CIRCLE IN GAIKHURI RANGE (CLOSED TO GRAZING).

The soil and geological formation are the same as in Margali block but the soil covering is forest growth or coarse high grass. *Gardeniæ* are not frequent. *Palas* is uncommon and *Zizyphus Œnoplia* rare, otherwise the species found are the same as in Margali. The stocking is complete or nearly so and the ground covered by young growth. The distribution of trees is uniform and not arranged in groups. Regeneration good. *Bija* and teak regeneration is good and the height-growth is good."

Of course, it must naturally be taken into account that the grazing area would never have been given up to grazing if it held good forest and the high forest was probably so constituted because of its good growth. Both areas have been protected from fire for a number of years. In the Margali block there are signs of the erosion of soil taking place, which I have not observed elsewhere. As this paper is based on observations from forests protected or otherwise for the last 16 years only, any conclusion that may be deducted from it must, of course, be accepted with caution, more particularly on the subject of soil erosion. The observations on the actual growing stock are, I hope, of sufficient interest to draw opinions of officers stationed in localities, where the conditions brought about by the grazing to cattle are different.

JAMES W. BEST,
Assistant Conservator of Forests.

UTILISATION OF WASTE WOOD.

Inquiries are from time to time received at the Imperial Institute from firms engaged in working forest concessions in British possessions as to the possibility of utilising waste wood produced in the ordinary timber-working operations. It has been thought desirable, therefore, to compile a short article on this subject with a view to affording general information as to the possibilities in this direction.

Apart from its use for structural purposes there are two main ways in which wood can be utilised at present, *viz.*, in the manufacture of wood pulp for paper-making, and by destructive distillation for the production of wood spirit, Stockholm tar and wood charcoal. For these purposes the cheaper woods are available, and for destructive distillation, especially the waste products of the various timber industries, are suitable. A full account of the wood-pulp industry has already been given in this *Bulletin* (1905, 3, 262), so reference need only be made here to other methods of utilising wood of little value and waste wood products.

Much of the wood refuse generally available, such as shavings, sawdust, chips, spent dye and tan woods, etc., is at present used as fuel, its value for this purpose being a few shillings per ton. In considering the disposal of such material it is important to ascertain whether local conditions will permit of the disposal of the products of distillation at a higher rate than would be obtained for the raw material as fuel. Indeed, in undeveloped communities where wood spirit, tar and charcoal are not saleable in large quantities, the destructive distillation of wood refuse is not likely to be remunerative or even feasible.

From air dried wood about one-third of its weight of charcoal can as a rule be obtained, this having an average value of from 17*s.* to 22*s.* per ton in districts where coal is not readily obtainable. Thus, from one ton of air-dried wood refuse, containing from 20 to 25 per cent of water, and consequently worth from 4*s.* to 5*s.* the value of the charcoal would be about 6*s.* In most countries there is little difficulty in disposing of the charcoal,

as its uses are numerous. Besides being largely employed in the manufacture of iron and steel and in the extraction of other metals, such as copper and tin, it can be used in sugar refineries for filtration and for various domestic purposes. Special use for the "small" charcoal obtained by distilling wood refuse are found in the manufacture of certain kinds of "smokeless" fuels, calcium carbide, and for packing cold storage chambers

Wood refuse can be carbonised more rapidly and at a lower final temperature than blocks of wood, a temperature of only 300° C. being adequate. One result of this is that the pyroligneous acid obtained in the distillate is of good quality, and fairly readily purified to yield acetic acid. Wood refuse is also more readily dried by exposure to the air, and does not require to be stored for a year or two before its content of water is reduced to from 20 to 25 per cent, which gives the best results, as is the case with blocks of freshly cut wood.

DESTRUCTIVE DISTILLATION OF WOOD.

In the destructive distillation of wood the blocks or refuse are heated in a suitable vessel provided with a small aperture fitted with a pipe. In modern practice the carbonising vessel is generally a cylindrical wrought-iron retort built into brickwork in a horizontal position. The retorts are of an average size of 3 metres long by 1 metre in diameter, and are made to hold anything up to about 4 tons of wood (a quarter of a "cord"). They are generally set up in "batteries" of two, and heated by the same fire from below. The naked flame is not allowed to impinge directly on the iron retorts, which are heated only by the hot furnace gases, this result being obtained by utilising iron or brick shields or arches. Before the application of heat all the orifices and connections are plugged with clay. The batteries of retorts are set up in rows, and the exit of each retort is connected with a warm condenser made of copper, and cooled externally by means of running water.

When the wood to be distilled is sawdust or scraps of very small size, such as spent tanning materials, dye woods, etc., it is

generally advisable to have the plant arranged in a special manner owing to the necessity of having the wood quite dry. This result is frequently obtained by building the retorts in such a manner that the hot gases from the one distillation are used to dry the wood refuse ready packed in another retort. The retorts are also sometimes made on a rotary system to facilitate even drying, and thus prevent unequal carbonisation.

A special form of kiln is said to be adopted on many of the large wood-distillation plants in Sweden, capable of treating wood in all conditions sodden forest timbers, saw-mill waste and ordinary air-dried logs. The general arrangement of the furnace is in the form of a long tunnel through which pass open steel cars, on which the wood is vertically stacked. The cars are taken through the furnace at an average rate of 22 per diem for perfectly wet wood, and about 36 per diem for air-dried timber. Uncondensed gases from the distillation are returned to the furnace and burnt, thus practically dispensing with the addition of any further fuel.

On the application of heat to the retort the substance of the wood is charred with the formation of volatile products, which are driven off. Those which are condensable are liquefied again in the condensers, and collected in suitable receivers.

PRODUCTS OF DISTILLATION.

Although the process of distillation is practically identical, whatever the kind of wood employed, the products obtained are different according to whether hard or soft wood is used

Products from hard wood.—Most of the wood distilled is hard, such as beech, birch, maple, etc, and is practically free from resinous constituents. Four chief products are obtained, *viz*, (1) an inflammable gas, which escapes from the condenser, and should, if possible, be returned to the fire to aid in heating the retorts; (2) a watery liquid known as "pyroligneous acid"; (3) wood tar, which is condensed with the pyroligneous acid; and (4) charcoal, which remains behind in the retorts.

The tar itself may be used as the fuel to create the heat necessary for distillation, and in this case it is sprayed with a jet of steam

and used in a similar manner to "oil fuel". In this manner the use of coal as fuel may be avoided completely

The charcoal is allowed to cool for a day or two, either before removal or in specially-devised "cooling chambers" out of contact with the air, or else it is drenched with water immediately after extraction from the retorts to prevent its spontaneous combustion in the air and consequent loss.

Purification of the products.—The tar and the reddish-brown pyroligneous acid are run off together into large settling vats, where separation is effected by the tar collecting at the bottom. Each is then distilled separately. As the tar and the pyroligneous acid are to a certain extent mutually soluble, the residue from the latter contains a quantity of tar, and the distillate from the former is distinctly acid in character. If the tar is to be utilised as fuel the acid is removed by passing the acid tar downwards over "bafflers" where it is met by an upward current of steam or vapours from the stills, to which the pyroligneous acid is given up. The chief products obtained by distilling the wood tar (which is itself an article of commerce, are light and heavy wood oils, wood creosote and the well-known product wood pitch, which is left behind in the stills.

In the most modern treatment of the pyroligneous acid an arrangement of plant known as the "three-still" system is adopted. In the first and largest still the crude acid is heated whereby the volatile acetic acid and "wood spirit" are driven off, and most of the dissolved tar is left behind. The outlet pipe carries the vapours into the second still, and passes them through a thin cream of lime and water. This absorbs the acetic acid with the production of calcium acetate, but does not affect the wood spirit, which passes on and is treated afresh in the third still in order to remove the last traces of acetic acid. In this manner the distillate eventually obtained is free from acid, and by suitable rectification can be made to yield pure methyl alcohol, commercial wood spirit and wood naphtha. The thin paste of calcium acetate remaining in the stills is run out and concentrated in large iron pans until it contains about 84 per cent. of "acetate of lime." This is the product which comes on the market as "grey acetate of lime."

Application of the products. The uses of charcoal have been enumerated above. Most of the acetate of lime is subjected to dry distillation, and is thus converted into acetone and calcium carbonate (chalk). The increasing consumption of acetone in chemical industries has rendered this process one of considerable importance. Besides being a useful solvent for varnish resins, acetone is largely used in the manufacture of smokeless explosives and celluloid articles, and its use will very probably be greatly extended in the near future. The present price of acetone is about £60 per ton, and takes about 40 tons of wood to produce 1 ton of acetone. The by-products in the distillation, the so-called "acetone oils," are also useful as "paint removers." Their formation is due to the presence in the pyroligneous acid of organic acids higher than acetic acid. Pure acetic acid is also prepared from the acetate of lime by distilling it with sulphuric acid.

Wood alcohol is used very largely for technical purposes. It is a useful solvent, and is widely applied for producing formaldehyde, for "denaturing" ordinary alcohol, and in the coal-tar dye industry.

Products from soft wood.—When "soft" woods, *i.e.*, resinous woods, such as those obtained from the various pines, are destructively distilled, the substances obtained are as follows :—(1) inflammable gas ; (2) light oils ; (3) pyroligneous acid ; (4) tar ; (5) charcoal. The pyroligneous acid so manufactured is inferior in quality to that afforded by hard woods. The principal fraction is the "light oil," which is usually collected in two portions, of which the lower boiling one is a kind of crude turpentine oil. This is a dark red oil of unpleasant odour, but after suitable treatment and fractionation it yields a nearly colourless spirit of characteristic odour, which is used as a substitute for ordinary turpentine oil. (Compare this Bulletin, 1906, 4, 215.) The best yields of products in this process are obtained from the heartwood.

STEAM DISTILLATION OF WOOD.

Besides the method of destructive distillation described above, a process of distillation with steam is gradually finding extended use for obtaining valuable products from waste pine wood. This

process only occasions the separation of volatile products (turpentine oil) already pre existent in the wood.

Pine-tree stumps, saw mill waste, and sometimes pine timber itself, are cut into chips and placed in a vertical retort fitted with a steam injection pipe. Through this pipe saturated or superheated steam is blown in, and turpentine oil, which is readily volatilised, passes out of the retort and collects with the water in a receiver, where it may be readily separated.

The residual wood, after drying a short time in the air, is suitable for fuel. The crude turpentine is rectified from a copper still, and yields a slightly yellow spirit of an agreeable odour which is readily saleable at a price slightly below that of ordinary turpentine oil.

ELECTRICAL PROCESS FOR THE DISTILLATION OF WOOD.

It is stated that a new electric process has been evolved recently in British Columbia for the utilisation of waste wood, and that the process combines destructive distillation with a primary distillation of the free turpentine oil contained in the wood. An experimental plant has been set up at Vancouver, B. C., where waste fir wood is obtainable from water-power at a low cost.

The wood is filled into oblong cans constructed to fit into special retorts, the brickwork of which is permeated with wrought-iron strips, through which passes a current of 110 volts. The temperature of the vessel, as measured by direct-reading pyrometers, rises from 75° C. at the start to 130° C., when turpentine oil begins to volatilise. The current is then shut off, radiation from the brickwork sufficing to complete the distillation. By the time the temperature of the can has risen to 150° C. on the outside and 205° C in the interior, the turpentine oil has been nearly all removed. The rosin contained in the wood melts and runs down to the bottom of the vessel and out through perforations, and is collected in the bottom of the retort.

The can containing the wood is now removed from the turpentine oil retort into an adjoining still, where the heating is continued and the wood residuum is destructively distilled as previously described. In this way the fresh set of products, charcoal, wood tar,

etc., is obtained quite separate from the turpentine oil and rosin of the first distillation.

It is stated that by this process the following yields are obtained per 1,000 lbs. of wood from British Columbia coast fir :—

Turpentine oil	...	...	6·7 galls.
Rosin ...	...	..	168·0 lbs.
Tar oil ...	...	...	5·1 galls.
Tar ...	...	...	68·0 lbs.
Charcoal ...	...	...	323·0 lbs.

The charcoal obtained is said to be of good quality, tough, and suitable for special purposes.

Owing to the absence of cheap supplies of raw material, wood distillation is not widely practised in the United Kingdom, but the distillation of sawdust, scrap wood, spent tar and similar materials is carried on to a small extent.

In many of the Colonies and Dependencies large tracts of forest exist frequently containing trees of little value as timber, and these might well be used in this way, where the products of distillation, and especially the charcoal, are marketable locally.

In Canada wood distillation is greatly on the increase owing to developments in the consumption of charcoal.

In Natal attention has been directed recently to the possibility of using wattle timber for destructive distillation after the valuable tanning bark has been removed. At present this timber is used for pit props and in other ways, but the demand for it is said to be much below the supply

Wood distillation has been undertaken recently in Victoria, Australia, and a large work has been opened near Warburton, drawing its supplies from the forests of Gippsland.

In India also there would appear to be a possibility of extending this industry. Owing to the religious prejudices of the natives it is necessary to use only wood charcoal in the refining of sugar intended for native consumption. This and the common practice of covering "godowns" with tar-impregnated felt opens out in India a market for two of the chief products of wood distillation.—*(Bulletin of the Imperial Institute)*

III

Photo-Mech. Dept. Thomason College, Roorkee. Photos. by Srinivasa u Nayadu.

IV

Cultivation of Acacia arabica (Babul) in Berar.

(For description of photographs see page 508).

THE CULTIVATION OF ACACIA ARABICA IN BERAR.

In compliance with the editorial footnote on page 505 of the September number Mr. Shrinivasalu Nayadu, Extra Deputy Conservator of Forests, Buldana, has courteously sent us the photographs to illustrate his paper. We accordingly publish in Plate 24, photographs I and II referred to on p 505 and in Plate 25 photographs III and IV referred to on page 508.

ORIGINAL ARTICLES.

A SHORT HISTORY OF THE DEVELOPMENT BILL OF 1909.

PART I.

[*Contributed*]

The Bill under the above title which was introduced for a formal first reading to the Commons by the Chancellor of the Exchequer at the end of August is one which must be of great interest to all foresters for it contemplates provision for the introduction of State Forestry as well as State aided afforestation into Great Britain and Ireland. And as many of your readers in India may not have so good an opportunity of following the progress of legislation from day to day as have those within reach of the London press, it was thought that a more or less concise account of the proceedings might be welcomed in the *Indian Forester*, for the Bill, if it passes, will mark an epoch in forestry in England and, if it does not, will surely pave the way to the introduction of State afforestation later on.

The Bill as it was presented was divided into two parts: *I.—Development, II.—Road Improvement*, but it is only the fate of development that will be here considered. The two subjects are so widely separated that it has occurred to more than one critic that separate Bills would have been more appropriate, but the proposals made under each head are somewhat similar as to compulsory acquisition of land and other matters and would have somewhat similar results in their effect on unemployment,

though happily this burning question has been completely eliminated from the objects in view, while at the same time the original proposals that the old Sinking Fund should be abolished has been dropped, as well as the creation of a commission to administer the new fund.

In terms of the Bill as presented the Treasury was empowered to appoint one or more Advisory Committees for the purposes of the Act, their duty being to advise the Treasury in the matter of "grants or loans for the purpose of aiding and developing forestry, agriculture and rural industries, the reclamation and drainage of land, the improvement of rural transport (other than roads), the construction and improvement of harbours and canals and the development and improvement of fisheries; and for any other purpose calculated to promote the economic development of the United Kingdom."

It was provided that all grants or loans should be made out of a separate fund which should be fed by—

(*i*) Sums annually voted by Parliament.

(*ii*) A sum of £2 500,000 charged in the Consolidated Fund and payable in five annual instalments of £500,000 each in 1911 to 1915.

(*iii*) Sums received by way of interest on and repayment of loans, and the profits made as the result of a grant or loan in cases where the repayment of such profits has been made a condition.

It was also provided that power should be given to the Board of Agriculture in England and the Department of Agriculture in Ireland to acquire land compulsorily, if necessary, for any purpose for which a grant was made to them.

The scheme tabulates as follows: -

(*a*) A Government Department or an individual requires a grant or loan for one of the purposes specified in the Act.

(*b*) The Government Department (or the individual through a Government Department) refers a scheme to the appropriate Advisory Committee.

(*c*) The Committee reports to the Treasury.

(*d*.) The Treasury retains the responsibility of making the grant or loan and is not bound by the recommendations of the Committee.

So far there would seem to the Indian official little to cavil at; the procedure is similar to that which would be adopted in India with the exception of aid to the individual. In India for the purposes of development, though grants of land and the produce thereon may be made to Railway and other companies, I am not aware that cash loans are favourably considered save perhaps to municipalities in distress, nor indeed are these as a rule made to Government Departments to whom a definite money grant is allotted when necessary for a definite purpose. But substituting the expert advice available with the Government of India for the Advisory Committees and the Finance Department, for the Treasury there is such a similarity of procedure that little public criticism would be aroused in India by the proposals.

In England where party spirit runs high and where any act of any Government appears in the eyes of the Opposition certainly suspicious and probably vicious the matter is different.

The *Times* which is of course noted for the absence of virulence and the suavity with which it enunciates the opinions of the Conservative party finds little but praise to record at the first reading of the Bill. "Other countries, it remarks, have funds applicable to the purposes of the Bill and there can be no doubt that great advantage has resulted to their peoples. The power to use the fund for any purpose calculated to promote the economic development of the United Kingdom will permit the expenditure of money on scientific research and experimental work of a kind likely to be beneficial to agriculture. Under proper safeguards the proposals of Mr. Lloyd George should result in considerable amelioration of the economic conditions of the rural districts of the United Kingdom."

The *Standard*, however, is not so reticent or complimentary. It says: "The first annual payment is to be made in 1911. By that time it is hoped and believed that Mr. Lloyd George will be

more usefully occupied than is at present the case. If all goes well—he will then be engaged in criticising the leading features of a Unionist Budget and explaining what a loss the country is suffering from having dispensed with his services as Chancellor of the Exchequer." This quotation which has no intrinsic value is given merely so that the party spirit before spoken of may be noticed. It is at times so strong as to hinder at least for a time the progress of measures in other countries long since proved to have been beneficial. The *Standard* continues: "Useful as the judicious stimulation of sylviculture might be, there would be certain obvious drawbacks to the States entering into a sort of partnership with either individuals or municipalities. This however is one of the most promising and least expensive of the projects believed to have engaged the favourable attention of Government. In afforestation conducted on true lines it should at least be possible to discover whether further outlay would be prudent or permissible. Also it will not be very difficult to regulate in some degree the expansion of the work according to the funds available and the local conditions of the labour market. Frankly we are not sanguine as to the prospects of this or any other form of State-aided speculation—for this is what it comes to—until the windy and headstrong clique who at present control the Cabinet and the Liberal party have been replaced by men of experience, knowledge and judgment. It is not a little disquieting that men so flighty and unstable may be allowed to play with public money. On the whole we think it would be safer not to extend their opportunities of doing mischief. And if this Development Grant Bill were once sanctioned by Parliament, it would be comparatively easy in any particular year for an electioneering Government to obtain a large vote which it might, and probably would, employ in a great scheme of collective bribery."

It will be observed that the sting of this essay is in its tail, and later on it will be seen that the suggestion that dishonesty and corruption are so rampant that the economic development of the country should not be permitted to proceed has not been allowed to fall on rocky soil. At the same time it must be remarked that

no party man can believe that the atrocities he attributes to his opponents can be literally true, though he would doubtless wish the public generally to be more credulous than he is himself.

The second reading of the Bill was taken on the 6th September and "speeches expressing approval of its objects were delivered from all quarters of the House. If therefore the Bill was made the object of a powerful attack from the Unionist side it was not from any lack of sympathy with its ostensible intentions." The hostility was based on the powers of expenditure secured to the executive "which must be regarded with the gravest misgiving if some better provision is not made for the control of Parliament." The objects of the Bill are freely admitted to be excellent, but it is held that "any Government armed with power to sanction and finance schemes of development of any kind, be they large or small, would be something more than human and something less than democratic if it succeeded in applying these powers without reference of any sort to its own political advantage The time and place chosen for the promotion of excellent objects might, notwithstanding their excellence, mean nothing less than the degradation of political life."

Thus the *Times* in milder language endorses the more vividly expressed condemnation of the *Standard* uttered ten days previously and leaves one to wonder whether political life which can stand accused of such dishonesty has not already reached the degradation from which it is desired to save it.

Lord B. Cecil opened the debate confining his arguments mainly to Part II of the Bill, but he included Part I in his charge that "the whole proposal was likely to produce a great waste of public money and it was almost certain to produce a very grave danger of political corruption." He insisted that the Bill was "all part of a gigantic scheme in order to bribe the electorate."

Viscount Morpeth who followed stated that under the Bill politics would degenerate into a mere scramble for money and that it would bring about political corruption—masquerading in the guise of a public benefit—on an enormous scale.

Mr. Channing spoke in favour of the Bill. He questioned whether the speeches of the two noble Lords were meant as serious contributions to the discussion for the policy of the Bill seemed to him to be the fulfilment of that which the Unionist party have been demanding for two generations He was against Advisory Committees desiring a larger representative body and he thought that afforestation, though it stood first on the Bill, was less important than agricultural education and research.

Mr. Chaplin agreed that Advisory Committees were not required, and that if expenditure under forestry was for anything more than experiment and instruction he thought it most unwise.

Mr. T. P. O'Connor remarked that many European countries had shown a vast industrial growth under development following legislation such as that proposed and that his colleagues (National) would regard its rejection as a grave national disaster.

Mr Bowles (Opp.) remarked that it was of the utmost importance to learn whether any promise had been given to the Irish Nationalist party in regard to the Bill. If so he would call it a corrupt bargain.

Mr. Munro-Ferguson said that it would be unwise to enter upon any scheme of afforestation involving millions of pounds and of acres. But a moderate expenditure during the next eight or ten years in carrying out the preliminaries necessary to any considerable scheme of State afforestation would be profitable. He maintained the value of Advisory Committees and said that no one with a proposal like this would dare to put forward names which did not carry public confidence.

After some other members had spoken, principally with regard to Part II of the Bill, the Chancellor of the Exchequer made a trenchant reply to his adversaries in which personalities were not entirely absent so much so that he fell foul of the speaker who adjudged that one of his remarks was of "a somewhat offensive character," and though the debate continued for some time after Mr. Lloyd George had finished, there was nothing more of special reference to Forestry brought forward At 2 A.M. (the debate having commenced at 3 P.M.) the closure was applied by 103

against 6 and the second reading of the Bill was reported to the House and it was then referred for the consideration of Standing Committee C. The results of the deliberations of the body will form the subject-matter of a future article.

(*To be continued.*)

REMOVAL PASSES AND SAWPIT LICENSES.

Forest Officers who have not served in Burma probably do not know the meaning of either of the above terms.

A removal pass is a permit without which it is not lawful to move forest produce by rail or river throughout Burma. The fee charged is only nominal. Each pass is issued in triplicate, one copy goes with the produce, another copy is passed on, in turn, to all revenue stations through which the produce should pass to its destination; after the consignment has been passed at the latter place this copy is returned to the division of issue.

Without a sawpit license it is not lawful to saw up any timber whatever within 5 miles of a river or 10 miles of a revenue station or Railway; the fee is small.

2. The value of any rule depends on the trustworthiness and efficiency of the men who have to look after it. Whether or not a gazetted officer can find the time to sign all such passes and licenses issued in a division, it is certain that it is quite out of the question for a gazetted officer to actually check the working of more than a small fraction of them. In view of the amount of work involved in issuing these passes and licenses, and the opportunity they gave, especially the sawpit licenses, for bribery and corruption on the part of low-paid subordinates, it is for consideration whether the issue of both might not be discontinued. I, for one, should be glad to see it done.

3. In India these passes and licenses are unknown. Why the difference? I can only think of one reason, *viz.*, that forests in India are relatively limited in extent, whilst in Burma they cover a large proportion of the total area of the province.

The opportunities for the illicit disposal of forest produce are, therefore, greater in the latter, and the chances of detection less. Still, it may safely be assumed that conditions in Burma as a whole are now very different to what they were some 40 years ago, when the first forest regulations were drawn up.

In some districts the change is more marked than in others, both in the Upper and in the Lower Province. Even if I am in a minority in wishing to see removal passes and sawpit licenses abolished throughout the province, I think many officers will agree with me in recommending that their application be limited to certain districts only. Criticism by officers with a longer and more varied experience of Burma is invited It would also be useful and interesting, if men in India would publish the fact in the pages of the *Indian Forester*, if they have ever come across conditions under which the need for similar regulations has made itself felt.

F. A. LEETE,
Deputy Conservator of Forests,
Tharrawady Division.

THE GROWTH OF PALMYRAS.

The Honorary Editor kindly sent me the specimens, referred to in Mr. A. W. Lushington's letter which appeared in the October number, for examination in connection with the previous papers on the subject by Messrs. Lushington, Jackson and Donald—(see *Indian Forester*, XXXV, pp. 148, 394 and 521).

The plants all show a small subterranean stem, its maximum length varying from 2" to 4" and maximum diameter from 1" to 2". In all cases the basal portion of the stem has apparently completed its growth in thickness, it bears no leaves but is marked with the annular scars left by the fallen leaves. It is obconical in shape, terminating below in a more or less decayed tap-root and furnished above with vigorous adventitious roots. Just above this basal portion the stem attains its greatest diameter and from here it again tapers upwards towards the apex This apical portion of

the stem is still immature and is obviously capable of further growth in thickness. Commencing from its base and passing upwards it bears in acropetal succession first the sheaths of the outer older leaves, only the basal portions of which are still alive, then, within and above these, fully developed living green leaves with sheath, petiole and lamina and finally, inside of all at the apex, the as yet imperfectly developed youngest leaves, the large sheaths of the outer leaves enveloping and protecting the younger leaves within. It will thus be seen that the diameter of the mature portion of this underground stem steadily increases from below upwards.

In all the specimens unfortunately the terminal bud and innermost leaf rudiments had been destroyed by rot so that the question of whether the young leaves first become visible at the apex as a complete or incomplete ring of tissue could not be decided. The youngest leaf rudiments seen however showed a circular insertion occupying the entire circumference of the stem. As the stem increases in thickness and more leaf rudiments appear towards the apex and centre of the stem, the sheaths of the outer leaves expand and grow with it until they attain their full dimensions. The further growth of the stem and expansion of the upper leaves thus results in the splitting of the outer sheaths which begin to separate from their insertions leaving scars behind them, each of which eventually forms a complete ring upon the stem.

In the small stems examined therefore each annulation on the stem corresponded to a single leaf insertion which is in agreement with the observations of Messrs. Jackson and Donald on older stems. In the specimens seen however the splitting and separation of the sheath from its insertion commenced at the junction of the edges of the sheaths and continued thence laterally on both sides The additional splitting and separating from the centre of the sheath laterally on both sides which appears to be characteristic of older stems was not noticed.

It is probable that, once the above-ground stem appears, the number of leaves developed each year may be practically constant. If this is the case, by noting the number of leaves developed

annually and the period of duration of the leaves, it should be an easy matter to calculate the age of an above-ground Palmyra stem from the annular leaf-scars.

A point worthy of note is that the apices of the small subterranean stems examined were situated at a depth of nearly 1 foot below the ground surface. In part at least this would appear to be due to the roots contracting and pulling the stem down into the ground. These plants are reported to be some 9 years old and both Messrs. Lushington and Donald report plants of 17 and 18 years old which have as yet found no aerial stem. It is obvious therefore that the early growth of Palmyra is frequently very slow, but once the aerial stem appears subsequent growth is apparently fairly rapid.

R. S. HOLE.

7th October 1909.

STRAY FOREST LEAVES, KANARA FORESTS.

The forests, bordering the Sahyadri and the Malayagiri (Nilgiri) mountains which are described as the Dandakaranya in the ancient Indian epics, were in ages past, so the legend runs, high and dense jungles sheltering, besides wild beasts, numerous wandering wild tribes known as Rakshasas or demons and a few highly civilised people living in small isolated cottages called the Ashramas. These thick jungles gradually became sparser and sparser through one reason or other, and only a few traces of those magnificent forests are now found in the Karnatak, chiefly in the North Kanara district of the Bombay Presidency. One of the main causes of the extensive denudation seems to have been that the ever-increasing population of the civilised race cleared fresh jungle tracts for their habitations on the one hand and their demands on the forest growth went on increasing on the other. The rainfall also decreased gradually year after year causing the fertility of the mountainous black soil (Karnatak meaning black country so named on account of its black soil) and the growth of

vegetation to diminish with it. All kinds of growth in the vegetable and relatively in the animal kingdom are chiefly dependent on rainfall, which in turn varies with the height, the heat, the winds and the distance from the ocean. The mountainous tracts are thus covered with denser jungles than plains on account of the larger rainfall there. There is, however, a common assumption to the contrary, *viz.*, that the rain is attracted by forests. Whether forests have any influence over rainfall or they are dependent on it is a question of natural philosophy. The sparse jungles, as they now are, are also being rapidly consumed notwithstanding the intelligent efforts of the Administration to obtain a fresh growth equal to, if not more than, the growth consumed, by way of systematic cutting and by raising nurseries and plantations. The consumption is going on at such a rate that there is every fear that in course of time there will be no trace whatever of the once magnificent forests of Dandakaranya although at present there is still something left. These mountain ranges being then barren will have possibly to be exploited for coal or other suitable material to take the place of timber and fuel and meet the wants of the increasing population as is the case at present in some of the Western countries. The ever-decreasing rain and consequently the gradual decrease of vegetation on the face of the earth, and the ever increasing numbers of the human race solely depending on both for their existence are serious problems even beyond the comprehension of the most profound understanding. Such evils are inevitable when natural products are not properly economised but are wasted, while the demands on the same go on increasing inversely with the supply—more demand, less supply.

The magnificence and utility of the Kanara forests are too well known, the chief distinguishing feature being that they comprise, besides high forest yielding excellent timber useful for even stately buildings, some peculiarly cool and shady areas covered with evergreen plants and creepers. The medical value of these little herbs among other things is not yet properly appreciated or rather is lost sight of at present, for the place of the Ayurveda

the Indian medical science, has been taken by other foreign systems of medicine. There were times, even before the introduction of the present allopathic, homœopathic, chromopathic and hydropathic medical systems, when this Ayurveda chiefly depending on vegetable essences was doing things that might now seem but fabulous. To this Ayurveda there is not a single leaflet or a blade of grass, a root or a bark, a fruit or a seed without its medical virtue. With the aid of the little herbs even lost animation was restored under certain conditions—that extreme possibility of which any perfect medical science could boast—a thing that would startle the exponents of all the other medical systems now in vogue. Forests seem to be regarded now only from the revenue point of view. A close botanical and chemical research will however disclose many wonderful properties of the innumerable little species now ignored but created for the use of the more perfect creatures. A correct identification of many of these herbs is hardly possible to the incompetent Ayurvedic physicians of to-day, the science having been ignored generation after generation. A proper knowledge of the more important herbs which former physicians acquired by tradition was kept by them as a secret. It was a family secret as it were They feared that a general revelation of the properties of herbs, owing to the latter being generally common, would tend to diminish faith—a condition of mind so essential to restore the body to its natural healthy condition. Other medical systems having stepped in and this science being ignored, such family secrets were often lost on the death of those who knew them. There are, however, some remnants of this traditional knowledge here and there with common people who scrupulously guard them. There is one in this district who professes to unite a shattered or dislocated bone, another curing rabies, and a third treating carbuncles with the aid of the little herbs all in a few moments or in a few days. Boils considered incurable by skilled allopathic physicians by their being located on dangerous places, are transferred to safer places, and are suppressed there if at earlier stages or opened if developed. There are others that cure the most deadly snakebites, though no good antidotes

are yet found for these poisons in any other medical science. Considering that there are only two Pasteur institutes—at Kasauli and Coonoor—in India, and also considering the difficulties of long travel and great expense, what a great advantage it would be if instead a general use could be made of the common herbs that can be found with no expense or difficulty. The family of the writer of this article possesses through tradition the medicine for treating "Serpa Kattu," a kind of virulent and burning eczema affecting the back and shoulders, creeping up to the eyes and often times ending in the destruction of the latter—a disease peculiar in the Kanara sea-coast country and incurable by the allopathic or homœopathic treatment. There are many such specifics still, mostly with common people (civilised people having recourse to allopathy chiefly) from whom it is very difficult to extract the secrets concerning them; it is a pity that they should be allowed to vanish like others have done. This is a matter worth the consideration of the Government; if it is possible to afford any facilities and inducements for such research, concerning, as it does, the welfare of humanity, something should certainly be done in this direction. The present Kanara jungles still known as the Dandakaranya abound with innumerable little species of medical value and in them can be discerned the wisdom of the beneficent hand that made them. Even an atheist that asserts that all things in this world are only formed by a fortunate combination of atoms will also be puzzled for a time as to whether there is not any hidden power in the leaflet that is so beautiful and useful, whether an Almighty Reality does not pervade even the smallest particle of this phenomenal world, and whether it is possible for the unbounded, incomprehensible universe to be without an Owner.

> "When I look at the poor little herbs that arise out of the earth, the lowest of vegetables, and consider the secret spark of life that is in them, that attracts, increases, grows and seminates itself and its kinds, the various virtues that are in them for the food, medicine and delight of more perfect creatures, my mind is carried up to the admiration and adoration and praise of that

God whose wisdom and power and influence and government is seen in these small footsteps of his goodness; so that, take all the wisest, ablest, and most powerful and knowing men under heaven, they cannot equal that power and wisdom of His that is seen in a blade of grass."—Sir M. Hale.

R. S. NAGARKATTI,
Forest Department, Belgaum.

SHIRALI, KANARA:
3rd September 1909.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

PROTECTIVE COLOURING IN ANIMALS.

Everyone is familiar with some of the instances in which the natural colour of an animal helps to hide it from view, remarks Sir Ray Lankester. Green caterpillars, for instance, are less visible when among the green leaves which they eat than they would be were they brown, blue, red, yellow, or black. The little green tree-frog is difficult to see when he is clinging to a leaf, because his colour is the same as that of the leaf. Sandy-brown coloured animals, birds, reptiles, and beasts of prey, are found on the sands of the desert; white birds, foxes, hares, and bears on the Arctic snow. The similarity of the colouring of these animals to that of the ground on which they live results in their escaping the observation of man's eye, and we are entitled to believe that they escape for the same reason the observation of other animals. They are thus in many cases protected from the attacks of enemies searching for them as prey, or in other cases they may themselves be enabled the more easily, in consequence of their concealing colour, to creep upon other animals and seize them as food. Some of the simple cases of this resemblance between an animal and its surroundings are easy to observe, and the value of the resemblance as protection, or as a means of secret attack, is plain enough.

But there are far more numerous cases in which the significance of colour as concealment, is not so immediately obvious. There are the curious stick insects, with long bodies and delicate long legs, sometimes with bud-like knobs on the body which look like bits of the branches of trees, not merely on account of their colour but on account of their shape. Shape or modelling has a great deal to do with the effective concealment of an animal. Then, too, there is the curious fact that some insects (and also some birds), when at rest on the stems of trees, are practically invisible, but, if they spread their wings, are conspicuous. The oak-leaf butterfly

of Assam and Africa is of a purple colour, marked with a great orange coloured bar on each fore-wing when the wings are open, and it is obvious enough. But when the wings are closed and the insect is at rest, the undersides only are seen, and are coloured so as to represent the veining and fungus marks of a dry brown leaf, so that not even a human observer, let alone a bird or a lizard, can distinguish, at two-feet distance, the butterfly from dried leaves placed near it.

A well-known little moth with pale green mottled wings, is the only case in which I have myself watched the protection afforded by colour at work. It was on a summer's evening, when I saw this little moth zig-zagging up and down with the most extraordinarily irregular flght, and a bird pursuing it. Twice the bird swooped and just missed his prey owing to a sudden turn and drop on the part of the moth. And then, to my great delight, the moth flopped against the stem of a tree on which was growing a greenish grey lichen. The bird swooped again close to the tree, but failed to see the insect, and quitted the chase. It took me an appreciable time to detect the little moth resting against the lichen, and closely matching it in colour. There are endless examples known of such "protective resemblances" some of them (such as that of the buff-tip moth, which, with its wings closed, looks like a broken birch twig) being most unexpected and fascinating. In the forests of Madagascar, the whitish-grey tree lichens are imitated by thread-like growths on beetles, tree bugs, locusts, and even lizards, with a wonderful concealing effect, and some other flat membrane-like insects, are so much like the greenish and yellowish bark of trees that we actually lost a specimen for some time in the case labelled "mimicry," in which a series of these things was arranged by me for the edification of visitors to the Natural History Museum. It was found after a day or two to have been present all the time with other specimens on a piece of bark from which it was indistinguishable.

Some eight years ago a distinguished American painter, Mr. Abbott Thayer, was able to add very importantly to our knowledge of the ways in which colour serves to conceal animals when in their

natural surroundings. Mr. Thayer was able to do this owing to the fact that he was a devoted student of woodland life. This, however, alone was not enough. Mr. Thayer had the special ability to deal with this subject which comes from the trained eye of an artist. He had, above all, the knowledge of "tone values" and of the illusive and delusive effects of false shading and of colour spots and bars, and of complementary colours and "irradition"—which only a painter who deals every day in the most practical way with these matters can attain to. Mr. Thayer showed eight years ago—and demonstrated conclusively by means of models, one of which he presented to the Natural History Museum at my request—that in very many cases it is of no use for an animal to be of the same colour as its surroundings, since if the animal (a bird, or a quadruped, or a fish) is of plump and rounded shape and is observed under the open canopy of heaven, a deep shadow will exist on its lower surface and make it as obvious as a shaded charcoal drawing on a piece of light-brown paper. But if the back of the animal is of a dark tint and its belly white or whitish, then the effect of light and shade is (Mr. Thayer showed) completely counteracted and the animal becomes totally invisible in its natural surroundings.

Mr. Thayer's model demonstrating this, consist of two life size wooden models of ducks seated on a stick—one to the left, the other to the right. The stick, with the two models on it, is fixed, horizontally in a box, which is open above (that is, has no lid) and is also open in front. The box is in fact a little stage, lit from above by the light of the sky, and its three remaining sides are sufficiently high to form a complete background to the model ducks whose perch runs across the "scene" at some 7 in. or 8 in. from the floor of the box The box itself is lined with a pale purplish-brown flannel, and each bird is tightly covered with the same material. When so prepared the box is placed on a table under a skylight (where it is to stay), the table being high enough to bring the ducks just below the line of sight. Of course, deep shadows are formed by the top-light on the under-side of the beak, head, and body of the models, and in spite of their colour being itself

identical with that of the walls of the box, they are as obvious as it is possible for anything to be. Now Mr. Thayer takes his paints and very carefully darkens the back of one of the ducks and whitens its belly and the under-side of its head and beak. The light and dark regions merge into one another along the side of the bird by skilful gradation. When this shading and whitening is finished and, of course, the perfection of the result depends on the continuance of the right amount of sunlight, (which is not a thing one can always insure in a London museum) the duck-model so treated is absolutely invisible at a distance of 10 ft. or 15 ft.—and even when one is nearer escapes notice—looking like a haze or vague shadow of a bird even to an observer who knows nevertheless that it is there and is really as solid and large as the untreated model by its side. If now some one stretches out his hand so as to cut off the top-light falling on the painted model, it immediately becomes as solid to the eye and as visible as the untreated one, and when the hand is withdrawn it melts away again like Banquo's ghost. The models made by Mr. Thayer were, so long as I was director, exhibited in the small room between the fish gallery and the central hall of the Natural History Museum, and, if they have not yet been removed, are well worth a visit

Mr. Thayer's models work perfectly, and astonish every one who sees them. The great point of interest about them however, is that the bird with dark back and light belly is really in the condition which is quite common in a number of birds, especially ducks and wading birds, where it must act as a means of concealing the bird—just as it does in the painted model. Of course, there are vast numbers of birds not so shaded, but it is possible to explain the darker and lighter colouring, in various arrangements seen in birds, as helping to produce concealment or disappearance from view, when the habits and natural surroundings of the bird are known. So too with many hairy quadrupeds (mammals, or "animals" or "beasts," as they are often called). The white hair under the tail and about the rump helps a running animal to escape the vision of its pursuer—blending, as Mr. Thayer shows that it does—with the white colour of the skyline. In the case of fish—

especially fresh water fish the dark back and light belly are very common, and although they do not help to conceal the fish when seen from above, swimming over a light coloured river-bed, yet when looked at by other fishes or by otters in the water, the effect of the light from above on this disposition of dark and light tints on the fish's body must be the same as that demonstrated by Mr. Thayer's "disappearing duck," and must often render the fish absolutely invisible, even at close quarters.

Mr. Thayer has pursued this object during the past seven years, and a few weeks ago he gave some interesting demonstrations in the Zoological Gardens in London. He showed a model of a white egret, which was but little noticeable when standing up clear against a bright, white-coloured sky. The plumes on the wings developed in the breeding season, were shown (by putting them on and taking them off) to assist in causing invisibility, since they made the side of the body flat and concealed the shadow on its rounded under side. A similar bird model marked with strong black on the neck and legs—the rest being white—refused (so to speak) to shape itself as a bird at all, and looked at a distance of twenty yards like a bit of rock or stump of wood with a twig and dead leaf attached. The effect of different tones of brown cardboard cut into the form of a butterfly, when seen on different backgrounds, was shown; but the most interesting experiment was made with a black green piece of card cut to the shape of a butterfly and fastened on to a sheet of dead-black cloth in the open air, in the presence of white cloud light of moderate brilliancy. At five yards one could see the outline of the dark-green butterfly-shaped piece; at fifteen yards one could just distinguish the edge separating the dark-green piece from the black cloth. Now Mr. Thayer stuck in the middle of the dark-green butterfly-wing a small circle of pure white (about one-third of an inch across). The effect was entirely to obliterate the previously visible edge; one could no longer see the dark-green area at all—one only saw a white spot on a continuous dark ground, the dark-green and black were merged into one. That is no doubt due to the powerful stimulation of the sensitive "retina" of the eye by the white light of the spot, the

feeble stimulation by the dark green and black, though these remain physically as distant from one another as before, ceases to affect the brain, which is, as it were, entirely occupied with the strong white spot. This, according to Mr Thayer, is the value to butterflies and other animals of a violently contrasted white spot or band on a dark green colouring. The fringe of white dots and connected white flakes nearer the centre of the wing – common on the wings of butterflies—has, similarly, the result of rendering the wing-outline imperceptible and the butterfly invisible. Many such relations of colour, spots and bands, as well as of dark and light markings, have been elucidated by Mr. Thayer, and will be illustrated by coloured drawings in the book which he is preparing on the subject.

While it is the fact that Mr. Thayer has thrown new light on the colour-protection and invisibility of animals, it must be remembered that there are other explanations of certain cases of brilliant colouring in animals besides that which he has so well illustrated. "Warning" colours, recognition marks, and sexually attractive colouring all certainly and demonstrably exist in well-known and in well-studied kinds of animals. It is very possible that some of these colour-markings have been produced by a slight change in what were previously "concealing" patterns or colour-markings. The tendency of the human observer is to regard any colour, spot, or pattern on a bird, fish, beast, or insect as a "mark" or distinguishing "sign." We examine these things at close quarters, and do not, unless we reflect a good deal on the matter and experiment with the object, realise that what is a mark of distinction or recognition when seen at a few inches' distance, may be an illusive and obscuring colour scheme when seen at a distance of some feet, and in natural and habitual surroundings. It is not unlikely that we shall arrive at definite knowlege of the psychological "sight interpretation" of animals by a further study of the subject. It is in the highest degree probable that the retinal picture produced in an animal's eye by certain spots of colour, shade, and light exhibited by another animal, are not interpreted by the receptive animal in the same way as they would be by a scrutinising,

inquiring, reasoning man, even one who is what we call a "savage". Moreover, though many English naturalists have travelled and seen "life and light" in the sunny regions of the earth, there are few students of the colour-markings of animals in our museums, especially in great cities, who have adequate experience of what colour-markings really can effect in the way of concealment and illusion when light and surrounding objects are as they are, in the tropics or sub-tropical regions. It is a fashion now-a-days in the best-provided museums of natural history, to exhibit stuffed beasts, birds, and insects in what are called "their natural surroundings." The fatal objection to such exhibition is that were the beasts, birds, and insects placed in their most usual "natural surroundings," they would be invisible!

It is the merit of Mr. Thayer to have drawn attention to these considerations, and to have carried out some interesting demonstrations of the more frequent significance of colour-markings as means of concealment and illusion than had been recognised before his work. At the same time, it is not possible to consider the yellow and black livery of wasps, of certain evil-tasting grubs, and of poisonous salamanders as anything but a "danger flag," a warning to other animals that the yellow and black animal had better not be bitten and tasted. So the previous experience of animals who have bitten yellow and black creatures is appealed to, and ensures the safety of the yellow and black gentry from tentative bites which would kill them. Other recognition marks by which ill-tasting, nauseous butterflies are distinguished, and in consequence of which they escape attack, and, not only that, but are "mimicked" (as the yellow and black poisonous wasp is mimicked by some innocuous flies which thus escape attack) by other pleasant-tasting butterflies which fly with them, are considered by Mr. Thayer to be wrongly interpreted as recognition or "warning" marks. He shows, with more or less success, that the markings of the butterflies known as *Heliconiae* are effective as concealment, and is therefore inclined to deny their value as "warning" marks, serving to indicate a noxious quarry best left untasted.

It is, of course, quite possible that what are "concealment markings" when viewed by an aggressive bird or lizard at a distance, may be recognised as "warning marks" when seen by the observers at close quarters, and it is also possible that the latter may have become the more important or only important result of the colour marks of a given butterfly which were once useful as "concealment." The possible change of significance of colour spots and markings in wild animals may be illustrated by the effect on human beings of the burglar's crepe mask. At the present moment probably the most prominent result of the appearance in a house full of people in the dead of night of a man with a crepe mask over his face would be terror to those who saw him. The mask would be interpreted as a "mark" or "sign" of evil, not to say violent intentions, on the part of the masked man. It would be "warning colour," and most unathletic individuals would severely avoid it; in fact, retire from it in alarm. But actually, the burglar's mask—as possibly some noxious insects distinctive markings—was not invented for the purpose of causing alarm. Far from it! The burglar, or noctural malefactor, dons his crepe mask in order to cover the white glitter of his face, and so to escape observation. In origin it is a protective colouration leading to invisibility, and only secondarily has it become a "warning colour" or "mark" at close quarters. There will be much more ascertained and much instructive discussion as to the colours and markings of not only animals, but also of flowers and foliage, before this wonderful subject is thrashed out. I have only been able here to indicate its outlines. —(*Indian Field*).

THE HABITS OF THE INDIAN SLOTH BEAR.

In the latest of a series of interesting studies in the Zoological Gardens, which have been appearing in the *Times*, there is an excellent account of the character of the Indian sloth bear known as the aswal, amongst others. Its habit of taking food by suction is said to make it one of the most entertaining creatures in the Zoo. "If a piece of biscuit be placed some three inches outside

the bars of the cage this bear puts its snout as near to the morsel as it can reach; there is a long whistling indrawing of breath, and the biscuit whee-ee-ep! –disappears into the animal's mouth as suddenly as if it had been jerked in by a piece of elastic. As a renovator of draperies on the vacuum principle a properly educated sloth bear would be invaluable. But, with all its air of ragged good-humour and its agreeable eccentricities it is a dangerous animal, with its long muscular forelegs and huge hooked claws. The tiger, it is said, learns to give it a wide berth in the jungles; and in captivity an aswal has proved itself the master of the polar bear itself." In these articles the fallacy of more than one popular belief in regard to some of the best known animals has been shown. There must be many people who from their childhood's days have thought that bears killed their victims by hugging them. This idea is quite wrong. "All bears seemingly follow the same fighting tactics, attacking first by striking with their paws and then, on coming to close quarters, endeavouring to clutch the adversary with their claws and draw it within reach of their jaws. This act of pulling an enemy, dog or man, close up to the chest to bring the teeth into play might easily be mistaken for hugging and doubtless gives rise to the belief." The acuteness of the bear and its dexterity with its claws are well illustrated by one which, recognising that if it ate honeycomb standing much would be lost, lies on its back holding the food above in its claws and so converts its own body into a sort of basket or saucer. It thus catches the drippings on its chest and stomach and licks them off at leisure.—(*Indian Field.*)

THE MONKEY EAGLE.

This is the popular name given by the Americans to a very fine forest eagle of the Philippines, which is said to prey chiefly upon monkeys, though it not unfrequently visits the villages and carries off domestic poultry. Mr. John Whitehead obtained the male of a pair which had their abode in the forest opposite his camp in the island of Samar, where he daily saw them on the

wing. One of his collectors shot the bird, and brought it into camp, and it was described by Mr. W. R. Ogilvie-Grant (*Bull. B.O.C.*, No. xl., p. xvii), who named it *Pithecophaga jefferyi*. The generic name has reference to its habit of preying on monkeys and the specific name was conferred at Mr. John Whitehead's wish in commemoration of his father, Mr. Jeffery Whitehead. In his paper on the birds of the Philippine Islands (*Ibis*, 1897, pp. 209-250, pl. v). Mr. Ogilvie-Grant remarked on the fact that so large a raptorial bird should have remained unknown so long. This went to show how easily these great forest eagles may be overlooked, and in support of this view he mentioned that during the years Mr. Salvin spent collecting birds in Central America he only once saw a harpy eagle. Whitehead's specimen is now in the British Museum (Natural History).

The Zoological Society has been fortunate in securing the first living example of this fine eagle brought alive to Europe; and as yet none has reached America. The bird was procured through the good offices of Mr. Willoughby Lowe, who had been collecting in the Philippines and secured a good collection of skins. He saw two of these eagles in the mountains of Montalban, Luzon, and their flight was compared by him to that of the goshawk. The bird was snared by natives, a young pig being used for bait, which seems to show that mammals other than monkeys form part of its prey. It reached England in the Spanish mail boat Lopey-y-Lopez, and on the passage was specially looked after by the captain and two passengers; its food on the voyage consisted of chickens. The general plumage is rich brown above and uniform creamy white on the underparts; the narrow pointed feathers on the sides of the head and occiput are pale buff with dark middles, and form a crest. The bill is extremely deep and narrow, of much the same type as in the black cockatoo, and the naked tarsi and feet approach those of the harpy eagle, which Mr. Ogilvie-Grant considers to be its nearest known ally. The bird has been placed in the vultures' cages near the south entrance, not far from a harpy eagle, with which it may be compared. We are indebted to Dr. Chalmers Mitchell for the information that another example

of this fine eagle, captured in Mindanao, was kept for some time in captivity, but eventually destroyed, as the owner feared it might escape from a somewhat insecure cage. From this it seems quite possible that other examples may be obtained for the museums and zoological gardens of Europe and America.—(*The Field.*)

VOLUME XXXV NUMBER 12

INDIAN FORESTER

DECEMBER, *1909*.

REPRODUCTION BY COPPICE SHOOTS.

The question of reproduction by coppice shoots is a most important one in India, for over a large area the fellings are based on the supposition that the stamps of the felled trees will coppice freely. It does not however appear to be recognised how great an effect the method of coppicing has on the results. In this number a correspondent enquires as to the most suitable time for coppicing teak, and he states that he has found that stools coppiced at different periods of the year give very different results. This is of course a well-known fact, but in practice it is generally found that work has chiefly to be done during the cooler part of the working season, *i.e.*, from November to March when labour is available and in order to allow of the resulting produce to be removed before the rains set in. The question requiring definite solution then is not so much the season at which trees coppice best but the manner of coppicing which gives the best results. The usual way in accordance with European experience is to fell the trees as nearly as possible flush with the ground and to trim or dress the stump so

that it is level with the ground all round and slightly higher in the middle in order to let water run off easily and thus defer the rotting of the stump. In some cases this dressing process is omitted altogether, generally because it is too expensive or sufficient labour is not available. In other cases no attempt is made to cut flush with the ground and the stumps are left four to six inches high. Finally in some private forests we see stumps of all heights left, just as the workmen choose.

Now Sal is one of the principal species which is coppiced in Northern India and there are perhaps more observations with reference to this species, and in the following remarks we refer to that species. How much they apply to other species is not quite known, and this is a subject which requires careful investigation.

We have had the opportunity for several years of observing the coppice shoots resulting from stools cut flush with the ground and carefully dressed in accordance with the accepted theory propounded in all text-books on European forestry, and as long ago as 1907 some observations of ours made in the Kheri Division were published in the Forest Botany portion of the report of the Board of Scientific Advice for India, 1906-07. It may be as well for us to quote them here: " Sal, cut level with the ground and the stumps dressed gives very poor results in the way of coppice shoots. In fact the greater proportion of trees above one foot in girth give no shoots at all. This appears to be due to the contraction of the wood (Sal being particularly liable to such shrinkage) causing the wood near the surface of the stump to part from the bark. The cambium is in this way killed to a depth of three or four inches below the ground. The dormant buds appear to exist chiefly in this region, and thus no shoots appear. It is probable that this could be remedied by cutting the trees about four inches above ground. The portion above ground would then dry up and coppice shoots would be produced in abundance from ground level."

In the same report a note of Mr. McIntire's regarding coppice in the Bengal Tarai is given : " In the damp climates cutting so as to leave stumps a few inches high seems to be more favourable for coppice reproduction than cutting level with the ground."

This year a careful experiment was conducted by Mr. Tulloch in the Bahraich Forest Division to ascertain the difference in coppice shoots resulting from stools dressed at ground level and from stools left untouched after the trees were felled at a height not exceeding six inches above ground. Two plots of one acre each were laid out side by side. They were coppiced in March 1909 and in one the stools were dressed and in the other they were not. On the 3rd June 1909 it was found that in the first plot 81 per cent of the Sal stools sent up coppice shoots and 92 per cent in the second plot. There was practically no difference in the number of shoots per stool or in the maximum height growth obtained. It was noticed that no stool in either plot over 4' 10" in girth developed any coppice shoots. This experiment bears out the belief held by many forest officers in this country that the dressing of stools in coppice fellings is not only not necessary but is even harmful. In this case the number of stools which gave coppice shoots in the first plot was probably higher than usual on account of the heavy rain which fell in April and prevented the stools from drying up as they often do in the hot weather. The results however show how dangerous it is to apply an axiom, which has proved to be correct for a temperate climate, to a more or less tropical climate with extremes of heat and cold, wet and dryness. In Europe the best results in coppice are obtained from stools carefully dressed to ground level, and if stools are left six inches high it is found that the shoots develop from the top of the stool, whereas in this country, at any rate in these Provinces, good coppice shoots are developed from ground level when the stumps are left in this manner.

We have recently had the opportunity of inspecting coppice with standard fellings which have been in regular progress over considerable areas annually for the past sixteen years. The results are extremely poor and the greater percentage of stools send up no shoots. The fellings in fact have had the effect of decidedly decreasing the proportion of Sal in the crop and yet in spite of the observed disadvantages of dressing stools flush with the ground, this method is persisted in because the working-plan

of 1892 prescribed it! We think it is time that it was recognised that a mistake has been made by adopting a European axiom blindfold, and we trust that all working-plans which prescribe dressing of stumps flush with the ground will be revised in the light of the facts which have been observed. The loss which has been caused by this prescription is enormous and further loss from this cause should be prevented.

The only case in which we know of a good crop of Sal coppice in reserved forests is one where the working-plan prescribes that each standard should be hammer-marked at the base, and the forest officer in order to be able to check that no standards were cut had to order that all stumps of trees for felling should be left six inches high so that it could be known that no hammer-mark was on them. The results were a perfect crop of coppice shoots all springing from ground level.

Bordering on our reserves in private forests where the fellings are quite unregulated, it is common to see a splendid crop of coppice shoots result, while across the boundary line in reserved forests managed on so-called scientific lines we find a very poor crop indeed. Under such circumstances it is difficult to make the people see that scientific forestry is a benefit to the community.

ORIGINAL ARTICLES.

A SHORT HISTORY OF THE DEVELOPMENT BILL OF 1909.

[CONTRIBUTED.]

Continued from page 625.

1st day.—We left the Bill in charge of the Committee C. for consideration. Their labours commenced on the 15th September and were inaugurated by *Mr. Chaplin* proposing adjournment as a protest against the fact that many of the amendments had only just appeared on the paper. After some discussion the closure was applied and the motion negatived by 36 votes against 12. It will not be necessary to refer specifically to similar incidents in the

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future, and this is only quoted to show how oral discussion may avail itself of the aid of technicalities to cause delay, which is one form of opposition. In England there is sometimes noticeable a sense of satisfaction that public business is conducted by talking instead of by writing as in India; no doubt both methods have their disadvantages and the reverse, but the Indian procedure would appear likely to lead to fewer personalities and less rudeness than the British.

Clause 1 of the Bill authorizes the Treasury to make advances for the purposes before specified in this precis and *Mr. Bowles* then moved the postponement of the clause in order that Part II of the Bill might first be taken. The closure prevented Forests from taking an inferior position to Motors and 29 votes to 11 threw out the motion. *Lord Morpeth* next proposed to vest the powers, which were to be conferred on the Treasury, in the Board of Agriculture, but it was pointed out that this would defeat the object of the Bill which was that the Treasury should dole out funds to Government Departments on the advice of experts. Many members of the Committee spoke for and against this amendment and many bitter remarks were recorded. *Captain Craig* said that junior Treasury clerks would be found mapping out schemes, *Mr. Joynson-Hicks* that control by the Treasury meant ultimate decision by the Chancellor of the Exchequer who would be influenced by the pressure by Members of Parliament, *Mr. Chaplin* that nobody was more likely to interfere with and frustrate schemes than the Treasury; *Mr. Munro-Ferguson* explained that the Bill would be most unsafe without the Advisory Committees and that with all its shortcomings the Treasury was the best security we had in England against log rolling. *Mr. Lloyd George* then appeared, the Committee having sat for 3 hours. His delay was due to the fact that he had not left the House till 4-30 A.M., but he seemed to be full of energy and declared that he could not submit to the amendment. The closure was then applied and 29 out of 40 members voted against Lord Morpeth's amendment.

Lord R. Cecil then proposed an alternative plan, *viz.*, that Treasury advances should be made in pursuance of a recommenda-

tion made by the Development Commissioners to be appointed under this Act and confirmed in a manner hereinafter to be provided. In his opinion a very great safeguard would be established if they had in existence a body of experts who would consider the matter quite apart from all political considerations and without whose consent no grant could be made. After various speeches, chiefly in favour of the amendment, the Chancellor of the Exchequer said he desired to consider the matter, and the Committee adjourned.

2nd day.—On the following day *Mr. Lloyd George* presented the views of Government in the proposed amendment. The dangers anticipated from the Bill in its present form were, 1st, that applications for money grants might be made for political ends, and, 2nd, that the fund might be converted into a sort of distress fund. He strongly emphasised the fact that this was not an unemployment fund and that local distress should be met by other means. Proceeding, he agreed to the appointment of a Commission of three, one of whom only should be paid at the rate of £1,000 a year, but he would not cut out the Advisory Committees as the Commissioners might want expert advice. The Commission should not be under the domination of the Executive and the more detached it would be the more reliable and the better able to produce good work. The Committee appeared to be pleased with this concession and the concensus of opinion being that the Commissioners would be chosen by their ability to look after development from a national point of view, the amendment was passed with cheers.

In continuing the debate it was agreed to extend the power of the Treasury to grant or loan money " through a Government Department to a public authority, University, College, institution or association of persons or a Company not trading for profit," and after an attempt to debar the Treasury from imposing terms and conditions instead of the Government Department concerned, *Mr. Bowles* moved an amendment to strike out the power to make advances for forestry, including the purchase and planting of land. It was complained that if enormous sums were spent in forestry nothing would be left for agriculture, but in spite of

reassurances on this point the amendment was put to the vote and forestry came out with a majority of 20 out of 25.

3rd day.—The third day's meeting was remarkable for what our German cousins call *Sturm und Drang* The members of the Committee were tired and hungry and could not even enjoy a smoke during the daily sitting of six hours and this led to undignified altercations. *Captain Craig*, who had to apologise for smoking a pipe in Committee, wished to confine research under the Bill to the United Kingdom, but failed to impress the Committee; next *Sir F. A. Channing* desired to include scientific and practical training in agriculture, the training of teachers and the building or adaptation of agricultural schools as fit subjects for Treasury grants, but the Committee by 28 votes to 5 held that the words of the Bill, *viz.*, "instruction and experiments in methods and practice of agriculture" covered all the ground. *Mr. Bowles* proposed that the extension of the provision of small holdings shall be a duty of the Commissioners, but failed in carrying his point, and the closure being applied the rest of the paragraph was carried by 24 to 9 votes.

There was then an animated discussion as to the Chancellor's methods of passing the Bill by means of closure. At 3 P.M. he moved the closure on the whole of clause 1, to which three pages of amendments were still outstanding and an uproar occurred. Some members of the Committee had already left the room refusing to serve longer and now *Lord R. Cecil* remarked, on the question whether the Chancellor had promised to include certain changes in the clause, that it would not make any difference if Mr Lloyd George had promised. This unseemly statement he subsequently retracted and apologised for, and the Committee adjourned in a state of excitement, members of the Opposition being very angry.

4th day.—The fourth day's discussion was devoted to clause 2 of the Bill. The Opposition members of the Committee endeavoured to transfer the granting of money for the purposes of the Bill from the Consolidated Fund to the Estimates in order to secure Parliamentary control, but were unable to pass the amendment. In the same way an attempt to apportion a fixed amount of the grant to

Scotland met with no success. The work of the Committee, owing probably to the week-end rest and shorter hours of business, was conducted without petulance or personality.

5th day. -At the next meeting, the Committee considered the question of land acquisition and various amendments of a minor nature were agreed to and thus the work on *Development, viz.*, the first part of the Bill, came to a close. It is believed that the Bill when passed by the Committee will be sent to the House of Lords before the Financial Bill. The final adjustment of the constitution of the staff and its powers will be apparent from the Chancellor's amendments, printed below, which replace clause 3 of the Bill and explain the term "rural industries."

CONSTITUTION OF DEVELOPMENT COMMISSIONERS.

After Clause 2 insert the following clauses :-

(1) For the purposes of this part of this Act there shall be established a Commission consisting of five Commissioners, to be styled the Development Commissioners and to be appointed by the Treasury, of whom one, to be appointed by the Treasury, shall be Chairman.

(2) Subject to the provisions of this section, the term of office of a Commissioner shall be ten years. One Commissioner shall retire every second year, but a retiring Commissioner may be reappointed. The order in which the Commissioners first appointed are to retire shall be determined by the Treasury. On a casual vacancy occurring by reason of the death, resignation, or incapacity of a Commissioner, or otherwise, the person appointed by the Treasury to fill the vacancy shall continue in office until the Commissioner in whose place he was appointed would have retired, and shall then retire.

(3) There shall be paid to not more than two of the Commissioners such salaries not exceeding in the aggregate three thousand pounds in each year as the Treasury may direct.

(4) The Commissioners may act by three of their number and, notwithstanding a vacancy in their number, and, subject to the approval of the Treasury, may regulate their own procedure.

(5) The Commissioners may, with the consent of the Treasury, appoint and employ such officers and servants for the purposes of this part of this Act as they think necessary, and may remove any officer or servant so appointed and employed, and there shall be paid to such officers and servants such salaries or remuneration as the Commissioners, with the consent of the Treasury, may determine.

(6) The salaries of the Commissioners and the salaries or remuneration of their officers and servants and any expenses incurred by the Commissioners in the execution of their duties under this part of this Act to such amount as may be sanctioned by the Treasury shall be defrayed out of the Development Fund.

POWERS AND DUTIES OF COMMISSIONERS.

(1) Every application for an advance under this part of this Act, whether by way of free grant or by way of loan, by anybody qualified to receive an advance under this part of this Act shall, if the applicant is a Government Department, be referred by the Treasury to the Development Commissioners, and, if the applicant is any other body, shall be sent by the Treasury to the Government Department concerned to be by them referred, together with their report thereon, to the Development Commissioners.

(2) The Commissioners shall consider and report to the Treasury, on every application so referred to them, and may for that purpose, if necessary, hold inquiries either by themselves or by any of their officers, or any other person appointed for the purpose.

(3) The Commissioners may also appoint Advisory Committees and may submit to any such Advisory Committee, for their advice, any application referred to them.

DEFINITION OF AGRICULTURE AND RURAL INDUSTRIES.

After Clause 4 insert the following clause:—

For the purposes of this part of this Act the expression "agriculture and rural industries" includes agriculture, horticulture, dairying, the breeding of horses, cattle, and other live stock and

poultry, the cultivation of bees, home and cottage industries, the cultivation and preparation of flax, and any industries immediately connected with and subservient to any of the said matters.

Your readers may now form their own opinion of the machinery proposed for the practice of development in England. Of the five Commissioners, two only will be paid servants of the public, the others will be giving their time and talent free. Naturally, therefore, they must be either men who look upon the post of Commissioner as a stepping stone to better things, or men enthusiastic in the matter of forestry, agriculture and rural industries and unhampered by monetary considerations. Hoping that they will come into the latter category we can then proceed to ask ourselves whether, under even these favourable conditions, forestry will have a chance against agriculture, the one an established the other a novel industry. We can look back on the history of forestry in India and recall how, in spite of the fact that agriculture in the East is so much dependent on forestry, the latter has always had to give way to the former, often, even not with benefit to either. And we will remember further that in India the forests bring in revenue to the State, and are permitted to use 50 per cent. thereof for progressive works, while in England forestry for 30 future years will bring in nothing, while agriculture, in its depression, could absorb every grant that could be reasonably made for its welfare. This being so, we may be somewhat doubtful whether, for the present, development means much afforestation. There is, however, one good hope and that is in "personality." In the discussion on the Bill Mr. Lloyd George gave it as his opinion that the policy and progress of any State Department was to a large extent attributable to the personality of a Minister. That this is undoubtedly the case we have ample evidence in India, and, as there exist forest enthusiasts in England and as amongst them there must be some with a power of propagating enthusiasm and of creating belief in their own views, we can await what the future may bring forth with good cheer.

THE PREVALENCE AND UTILITY OF *XYLIA DOLABRIFORMIS* IN THE CENTRAL PROVINCES.

Gamble, in his Manual of Indian Timbers, states that this species is not found north of Chanda in the C. P., and Brandis states that Moharli Range of that district is its northern limit. It is found, however, more or less in the hill forests of Bhandara, Nagpur and Balaghat, but not in the Sal forests of the latter division or in the eastern part of the Raipur and Bilaspur districts.

The writer believes he is right in stating that it is unknown in Berar. It may be found further north than the Seoni district, but its locality appears to be confined in the C. P. to the catchment area of the Wainganga river. In Bhandara, it is chiefly found on the slopes of hills between 1,000 to 2,000 feet in elevation, mixed with other species prevalent in the C. P. type of forest. The more mature specimens are mostly crooked and barely over four feet in girth. Some have been found, however, with a sound straight bole of five and six feet girth. Such specimens are rare however. Seed-bearing trees are usually from one to two feet in girth mixed in equal proportion with other species.

It is very frequent in the sapling stage forming a dense crop under teak, Bija-sal and other trees, and one is led to the conclusion that under favourable conditions of fire-protection, it will oust the more light demanding species and form an almost pure crop.

Fire-protection seems to be responsible for this condition since the younger growth is remarkably in excess of older trees, and unless the young trees dry up on reaching a certain age, and there are no reasons to support this supposition, the only explanation of the marked preponderance of this species over its associates in the younger stages must be the successful fire protection of the last fifteen years because, previous to that period, there was little fire-protection in the division. There are no records to show that this species is specially favoured in the struggle for existence by fire-protection elsewhere than in the C. P., but the germination is reported to be rather aided than damaged by fire in South Kanara.

The assumption that in these Provinces fire-protection specially favours *Xylia dolabriformis*, is borne out by the fact that the species is not found in such numbers in the younger stages in unprotected and adjacent private forests otherwise under equally favourable conditions as the fire-protected forests. The growth of the young crop is at present good, the seedlings and saplings growing up under comparatively dense cover as straight poles, and there are no reasons to suppose from the condition of the young crop that the height and girth increment will not be at least as good as that of the existing older crop of other species.

Assuming that fire-protection is abnormally favouring the reproduction and growth of this species, the question arises whether the change of crop will be to the advantage of the forest and its commercial value. In the writer's opinion, anything that will help to increase the cover and soil protection in the present poorly stocked forests of these Provinces, will be a distinct improvement apart from the commercial value of the crop. In the higher parts of Ga.kuri range of the Bhandara division, the crop is at present very poor, badly grown *Terminalia tomentosa*, *Buchanania latifolia*, *Anogeissus latifolia*, *Diospyros Melanoxylon*, *Xylia dolabriformis*, etc., being mostly found scattered about over grassy *maidans*, and if this crop can be replaced by a healthy growth of *Xylia dolabriformis* there can be no doubt of the advantage of the change.

In the better class of forests, where there is often a complete leaf canopy and the more valuable species such as teak or *Pterocarpus Marsupium* are frequent, there is the danger that too dense a mass of *Xylia dolabriformis* will prevent the regeneration of the more light demanding species. The conditions in the Dudhara block are already showing signs of soon becoming similar to those of a mixed beach and oak wood in Europe, with the danger of the exclusion of the more valuable and light demanding species (in this case the teak) by the more shade bearing *Xylia*. On the other hand, at present the *Xylia* are acting as excellent nurses to the teak and Bija-sa. drawing them up and keeping their boles clear.

If it is found, as a result of testing the timber taken from the few large trees of this species already existing in Bhandara division, that the quality and strength is good, there are reasons for hoping that the forests of the Wainganga valley will, at some future date, be capable of producing sleepers of *Xylia dolabriformis* equal in quality to those cut in Burma.

JAMES W. BEST,
Assistant Conservator of Forests,
Bilaspur Division.

SHIKAR, TRAVEL, AND NATURAL HISTORY NOTES.

MY SHIKARIS.

We read a great deal of the doings of sportsmen in pursuit of big game, but it is to be feared that the shikaris, to whom success must be largely due, are not generally given sufficient prominence in narratives of this nature. In many cases, particularly in tiger hunting and in shooting in Kashmir, everything except the actual shooting of the game is done by the native shikaris. This has not been the method of the present writer, whose aim has always been to do as much as possible himself; but in many instances the sportsman who has a tiger driven under the tree where he is sitting, rifle in hand, has had nothing to do with the process of bringing the animal there, while the hunter in Kashmir frequently has all his stalking done for him and is "personally conducted" within range of his game. And in arranging the details of the hunt, in seeking for tigers, in examining the "kills," in organising the beat, and in the beat itself the unarmed shikari has generally to face far greater dangers than the sportsman, while surely the beaters must be brave who, armed only with a hatchet or a stick, enter the jungle to drive the fiercest of wild beasts from its lair.

The first of my shikaris was Muhammad Mir, of Bandipura, who, nearly twenty years ago, initiated me in the sport of big game hunting in the mountains of Kashmir. Previous to this my only experience of big game was in an abortive expedition after oorial in the Jhelum Salt Range, under the guidance of Yakub Khan, shikari of Peshawar. Muhammad Mir was a fine shikari, who knew well the habits of the wild beasts, principally red bears, of which we were in pursuit, and under his instructions I was soon able to stalk without his assistance.

The best of all shikaris was the old Bhil, Bhima, by whose skill and cunning many tigers were brought to bag. Never was

there a man with such a remarkable eye for country. He lived in a small hamlet on the bank of the Pein Gunga, where he cultivated his land, and, it was whispered, was not entirely innocent of dacoity. Most of these village shikaris are of little use beyond the neighbourhood of their own dwelling places, and are lost in new country. But even in unknown ground Bhima took in the situation with unerring eye, and invariably knew which way to drive a tiger.

Bhima was inclined to be lazy, and it was difficult to make him undertake the examination of a fresh tract of country. But once a tiger had been marked down his advice was invaluable in the posting of the stops and the arrangement of the beat, and a tiger marked down by him was as good as dead. He was, like all great men, masterful and greatly feared by all his subordinates in camp, and he had a great liking for rum and rupees. Some accused him (behind his back) of cowardice, and said that his heart turned to water when a tiger roared in the drive. Certainly he did on one occasion—and small blame to him—disappear in a retrograde direction when I was following on the blood tracks of a wounded tiger in heavy jungle. He wished to leave it until next day, and was perhaps wiser than his master. But I have seen him come stalking up the nullah all alone, driving in front of him a tiger with a flourish of his spear and a string of objurgations, as though it were a sheep. Bhima used to humour his tigers and bring them along gradually, so that they seldom galloped in the beat. He succumbed to plague some years ago, and no better shikari ever went to the happy hunting grounds.

Then there was old Indru, the Gond, who had never seen a white man in all the seventy years of his life when I found him living the simple life, like the wild beasts, which inhabited the solitudes of the forest where he dwelt. He was a black and wrinkled old man, carrying a long matchlock, with which he had done much execution, generally lurking over the water holes, to shoot the animals as they came down to drink. He was too old and decrepit for hard work, but had great influence among the younger shikaris in the districts over which he ranged. Many

years before he had been wounded in an encounter with a bison and bore the scar on his side. Strangely enough, he was killed by a bison two years after I met him, when following up the animal which he had wounded.

Kanha was another of my followers, a man of substance, who lived some twenty miles from Bhima. He owned a considerable amount of land about his village, the precincts of which he had not left until his love of the chase induced him to join my camp and accompany me on a distant excursion. He was a good and trusty servant who on our second expedition discovered a place where four or five tigers were always to be found, and where I killed three in two days one year and three more the next. But on my second visit Kanha did not accompany me, for he had already passed away—

I have met with and employedmany other village shikaris in the course of my wanderings. There was Kamaji, killed by a panther at the same place where I was myself severely wounded by one of those animals a year later, and Kamaji, who accompanied me on two very successful expeditions, during which he assisted at the death of twenty-five tigers. For hard work he had no equal, although he was not as wise and skilful as Bhima. His tigers usually galloped, while Bhima's generally walked, and some of them escaped, when Kamaji, being sensitive, used to weep bitterly. But he was a man worthy of all admiration—brave, honest, and truthful, and now that Bhima is gone I could wish for no better shikari to accompany me on my next expedition. He still resides in his hamlet on the bank of the Pein Gunga, surely the most delectable spot on earth, where the spotted deer call at morn and at the setting of the sun, and the tigers prowl nightly on the margin of the stream.

Besides the shikaris who have been named, a number of jungle men have joined my camp on various occasions. Each year when, at the beginning of the hot weather, my tents were pitched on the bank of the Pein Gunga, these faithful followers flocked to the standard, bringing news of the tigers which inhabited the forest in the neighbourhood of their homes. It always seems to me that

sportsmen are prone to ascribe too much of their success to their own prowess and too little to the skill and labour of their shikaris and the courage of the beaters. Personally, I am very conscious that a great deal of such success as has been my lot was due to the efforts of my faithful followers. However much one may do personally, it is impossible to range in a few days a tract of country for a distance of some ten miles round one's camp. I have found wild Gonds living among animals, scarcely more wild, in the depths of the forest. They knew well all the tigers and their idiosyncrasies, and could point out their haunts and the most likely spots in which to look for them. Sometimes these men were very shy and secretive, but information was elicited and their assistance given when their confidence had been obtained by kind and liberal treatment.

In the Deccan the Brinjaras are among the best of shikaris, and they are plucky and trustworthy in beating for dangerous game. They are themselves fine hunters, and, armed with spears and accompanied by their dogs of famous breed, they run down their game. Few carry firearms, but they are wonderfully expert at knocking over hares and even birds on the wing with sticks and stones. The haunts of the great predaceous beasts are frequently known to them owing to the depredations committed by these animals on their flock and herds. In beating for tigers I have always been glad to get a Brinjara naik and his following, and I recollect how one great tiger, trying to break out of the beat, rushed up the hillside, scattering the beaters : but a Brinjara naik, seeing that the tiger would escape, led his band in a charge against the beast, and, uttering fierce shouts, drove him grumbling down the hill, where Bhima brought him up to the waiting sportsman.

In most of the country over which I have wandered the trackers are not good, and tracking appeared to have been little studied by my shikaris. But at Jaum, some twenty miles from Hingoli, there were some wonderfully good trackers of the Ahnd tribe. The village of Jaum stands on a slight eminence beside a gently flowing rivulet. In the hot weather the rivulet dries up, or may contain here and there a pool of water, while the surrounding

country is then almost an arid waste—a range of low, stony hills, sparsely scattered with boulders and bushes and scarred by deep ravines, where bears, pigs, and panthers find rest and shade from the heat of the scorching sun. In these hills there were always a few panthers and bears to be found with the aid of the Ahnd trackers, who would trace the velvet-footed panther to its lair, and follow up nocturnal bruin even over the hardest ground, where the displacement of a stone or the scratch of a claw was sufficient to indicate to them the direction taken by the game. Among them old Mahadu, who had an ancient flintlock, could almost detect a footmark on solid rock, and on one occasion he tracked down for me a panther and bear, which were both shot one morning.

I have kept to the last the more civilised shikaris, who were in permanent employment. There was old Nathu, grown garrulous with advancing years, and too fond of relating the doughty deeds of himself and his master, with the addition of many imaginative embellishments. Better in pursuit of small than of big game, Nathu was no less a mighty hunter. Fearing nothing, I have seen him face the charge of a wounded and infuriated tigress without flinching, standing to receive it with a stick as his only weapon, and he would rush up to a wounded and dying tiger or panther and belabour it with tongue and stick. Simple minded, and honest and truthful in all his dealings with his master, ready to carry cheerfully through the long hot day's work the burthen of his sixty years, Nathu was a great addition to the camp in point both of utility and gaiety, and his tongue could be heard wagging far into the night when loosened by rum after a tiger had been slain, when he related how, single-handed, he faced the ferocious animal, and drove it towards his master as though it had been a sheep

The most faithful and admirable of all was perhaps little Chunder, the gentlest and most attractive of beings, and possessed of rare honesty and intelligence. His were no great deeds of prowess, but he contributed to the success of expeditions as much as any. He was a trustworthy man to send out to explore the country beforehand, to conciliate the inhabitants, and to bring back

intelligence that could be relied upon, and no one could have a more faithful attendant. On one occasion he and Nathu stopped in the line of a swarm of angry bees we had disturbed, and, as I subsequently learnt, covered my retreat at the expense of their own persons, drawing off the bees to attack themselves.

In situations of danger, too, one's soldier orderlies can always be trusted to play a manful part. My orderly, Shaikh Karim, seized by a tiger, which left him severely wounded, called out to me not to mind him, but to go on after the tiger, and on another occasion he faced and killed a tigress that was charging the line of beaters. Another soldier, Gopal Singh, when I was seized and borne to the ground by a panther, rushed up to it and beat it over the head with my gun. Such instances might be multiplied, and this comradeship and the life in camp in pursuit of game engenders close, friendly relations between master and man, irrespective of colour, or race, or creed.

I only hope that, when the time comes for me to depart for the happy hunting grounds, those who have gone before will be there to meet me with news of the sport to be had, and that those who follow after will join the camp on the bank of the Stygian stream.—(*By R. G. Burton in the Field.*)

IMPROVEMENTS AT THE LONDON ZOOLOGICAL GARDENS.

The new sanatorium which will prove to be the most interesting house in the London Zoological Gardens is, we understand, completed. In it, the sick animals and birds will be treated and operated upon under ideal conditions, which have not up till now been obtainable. The nurses are, we learn from the *Indian Field*, trained men, who have served an apprenticeship at the Tuberculosis Commission's Experimental Farm. They will never leave their charges unwatched, night or day, and the elephant with nerve troubles or the chimpanzee with bronchitis will have an equally fair chance of recovery.

The new system which is now, we believe, in full operation was explained by Dr. Chalmers Mitchell, the Secretary to the Zoological Society. "Roughly, quite half the deaths at the gardens," he said, "occur in the cases of animals which have only been from two or three days to a week at Regent's Park. In the cages in the past these have been too often a centre of infection. Now each new arrival undergoes a period of quarantine in the isolation sheds on the North Bank. If given a clean bill of health they go to the cages; if not, they will when the hospital is completed, go there.

"An operating room, which will take most animals, is being fitted up, but the largest animals will be anæsthetised (after taking an opiate), and operated on in their cages. A *post-mortem* room for inquests will also be attached.

EXTRACTS FROM OFFICIAL PAPERS.

SHORT COURSES IN PRACTICAL AGRICULTURE AND IN OTHER ALLIED PRACTICAL SUBJECTS AT PUSA.

The function of the Pusa College in the general scheme of Agricultural Education in India has been defined as that of a Higher Teaching Institution and Research Station for post-graduate agricultural students and for advanced science students, particularly from Indian Universities.

At the present stage of development of the Provincial Agricultural Colleges it also seems necessary for the Pusa Institute and Estate to assist Provinces and Native States by instituting short courses of instruction in the special branches of agriculture or in simple industries connected with agriculture. There are now facilities at Pusa for thorough instruction in the subjects referred to. Such instruction cannot well be given in other parts of India for at least some years; therefore, I hope that a hearty response will be given to the proposals which I note below.

The short courses which I propose are broadly defined in a syllabus for each subject which is appended hereto. I attach the greatest importance to the value of these courses. There is an

undoubted demand for them, but it is impossible to get at present elsewhere in India such simple technical instruction except as a part of a much longer course. The instruction will be essentially practical in character and will require no scientific training and not even a knowledge of English. It would, however, be an advantage if the men had all a fair general education.

Men who have not the instincts of the professions which they are following or propose to follow will not be accepted. I desire to admit in particular to Pusa for these courses men who are *bonâ fide* agriculturists or *malis* by caste.

The courses will be suitable for men of the subordinate staff of all the Agricultural Departments, and will be open to private individuals, who are engaged or propose to engage in the special branches of agriculture and allied subjects dealt with. It is not possible at first to take more than 9 students in each subject at one time, but several subjects can be simultaneously taken up by the same students.

A recommendation by a Director of Agriculture or any other authorised authority will be accepted in regard to any application for admission, if the applicant is certified to be of good character and in robust health.

Free quarters of a very simple but sufficient character will be provided.

Students will have to pay all travelling and personal expenses. The latter at Pusa need not exceed Rs. 15 per mensem and might easily be less.

No books will be required.

It is proposed to start classes as soon as possible ; so applications should be addressed to the Director and Principal, Agricultural Research Institute, Pusa, Bengal, at as early a date as possible.

SYLLABUS OF SHORT COURSES.

Section of Agriculture.

(1) *Cattle Breeding and Management.*—The course will occupy three months. It will deal with the general

management of breeding herds and of milch and draught cattle and will include simple instruction in the recognition, treatment and prevention of the more common diseases. The second Imperial Entomologist will deal with the principal insect-pests of cattle, the part which they play as disease-carriers and methods of treatment. Courses will commence in October and January.

(2) *Poultry Management.*—This will be a three-months' course and will include instruction from the second Imperial Entomologist in the treatment of the insect-pests of poultry. Courses will commence in October and January.

(3) *Dairying.*—This is intended to be a complete course, extending over six months, in up-to-date dairying.

(4) *Tillage Implements and Agricultural Machinery.*—Training will be given in the principles of construction and in the handling of the common Indian and European tillage implements and agricultural machinery, including ploughs, drills, cultivators, water-lifts, steam-engine, oil-engine, etc. Arrangements have been made for a complete collection at Pusa of all useful indigenous agricultural machinery, implements and tools. The course will occupy three months and will commence in October or January.

Section of Economic Botany.

(5) *Fruit-Growing.*—The course will be an eight-months' one and will deal with—

(*a*) The general management of a fruit garden, including choice of site, laying out, draining and planting, the choice of varieties, irrigation, cultivation and manuring.

(*b*) Special processes such as budding, grafting, layering, pruning and root-pruning, weathering.

(*c*) Disposal of fruit, including picking, grading, packing and marketing.

(*d*) Evaporating, drying and preserving.

The course will begin each year on the 1st of October and will last till the end of May.

Section of Entomology.

(6) *Eri-silk as a Cottage Industry.*—The course will occupy about three months and will commence in October and January. It includes rearing and spinning. If dyeing and weaving are to be learnt, three months more would be required.

(7) *Lac Cultivation as an Adjunct to ordinary Agriculture.*—The training can be given only from May 5th to June 15th or September 20th to October 20th. These dates vary a little according to the season, as lac does not always come out regularly. The training includes pruning and handling of trees, inoculation of lac, harvesting, scraping and washing. It covers the whole industry to the production of seed lac and is exclusive of the production of shellac.

(8) *Mulberry Silk Culture.*—The course would include rearing, selection of disease-free eggs, reeling and the utilization of waste cocoons. Instruction would also be given in the varieties of silk-worm. Silk-twisting (spinning) and dyeing, with the simpler forms of weaving, could be taught. The course would occupy six months if it ended at the reeling, nine months if it included twisting, dyeing and weaving of simpler fabrics. The training would cover only the ordinary existing methods, not improved methods or reeling of the more complex forms of weaving. The course will commence on June 15th each year.

J. MOLLISON,

Inspector-General of Agriculture in India.

15th September 1909.

MISCELLANEA.

NATIONAL AFFORESTATION.

BY THE RIGHT HON. SIR HERBERT MAXWELL, BART.

(*Continued from page* 604.)

The extent to which the United Kingdom has come to rely upon foreign imports of timber, and the progressive rate of our consumption during a period of twenty years, may be seen in the following tables compiled from the *Statistical Abstract* :—

A.—QUANTITIES OF WOOD AND TIMBER IMPORTED.

(*A load of timber*—40 *to* 50 *cubic feet*—1 *ton.*)

Wood and Timber.	1886.	1905.	Increase.	Decrease.	Percentage.
HEWN :—	Loads.	Loads.	Loads.	Loads.	
Fir	1,388,278	2,596,078	1,207,800	...	86·9
Oak	95,178	145,663	50,485	...	53·0
Teak	40,895	60,976	20,081	...	49·1
Unenumerated ...	58,411	53,834	...	4,577	7·8
SAWN OR SPLIT :—					
Fir	3,554,769	5,797,922	2,243,153	...	63·1
Unenumerated ...	231,017	188,604	...	42,413	18·3
STAVES	130,717	119,182	...	11,535	8·8
WOOD PULP ...	117,683	578,012	460,349	...	391·2
FURNITURE WOODS :—	Tons.	Tons.	Tons.	Tons.	
Mahogany	48,732	95,548	46,816	...	96·0
Unenumerated ...	50,717	197,111	146,394	...	391·2

Dye-woods, tanning materials, wood-pulp boards and some other forest products are not included in this return.

B.—DECLARED VALUE OF WOOD AND TIMBER IMPORTED.

Wood and Timber.	1886.	1905.	Increase in 20 years.	Increase per cent.
HEWN :—	£	£	£	
Fir	2,191,254	3,495,523	1,304,269	59 5
Oak	540,242	875,875	335,633	62·1
Teak	498,257	876,654	378,397	75 9
Unenumerated ..	192,483	225,753	33,270	17·2
SAWN OR SPLIT :—				
Fir	7,813,046	14,469,574	6,656,528	85·5
Unenumerated ...	392,446	785,756	393,310	100·2
STAVES	532,117	553,092	20,975	3·9
WOOD PULP	724,955	2,759,627	2,034,672	280·6
FURNITURE WOODS :—				
Mahogany	402,935	820,995	418,060	103·7
Unenumerated ..	407,562	1,170,785	763,236	187·2
Total ...	13,695,297	26,033,647	12,338,350	90·0

In three classes only has there been a decrease in the quantity imported, namely, unenumerated hewn wood, 7·8 per cent. unenumerated sawn wood, 18·3 per cent., and staves 8·8 per cent., but even in these the rise of value has been enough to cause an increase in the amount paid for the diminished quantity of 17·2, 100·2 and 3·9 per cent. respectively. The returns for 1907, a year of great industrial activity, will doubtless show a considerable advance, both in quantity and value, of timber imports. The coal trade was booming in that year, and the amount of hewn fir swallowed up annually by coal mines as prop-wood is enormous. It vexes one to perceive that the British Government and landowners have not only sacrificed, by want of foresight, the profit which they might have secured as producers, but have to pay for

more dearly as consumers in competition with other industrial communities. The two classes of timber which bulk most largely in our imports—hewn and sawn fir—are just those which all experts agree in declaring could be most readily grown in the United Kingdom :—

> Your Commissioners (runs the Report) find that the comparative neglect and failure of sylviculture in the United Kingdom is not in any sense to be attributed to natural or inherent disadvantages of soil or climate, but that on the contrary the conditions which prevail in these islands are favourable to the production of high class timber if scientific methods of afforestation be pursued. . . Even at present prices, sylviculture should prove a safe and remunerative investment ; but when the highly probable advance in the value of timber is considered, it does not seem unduly optimistic to expect that enhanced profits will accrue.

The possibility of growing timber for profit in this country is regarded by many persons with scepticism, even by those who do not contest the universal opinion of Continental experts that our climate and great portions of our soil are admirably adopted for tree growth.* They point to the numerous cases where landowners have fine timber to dispose of and cannot get a decent price for it, and they overlook or disregard the obvious reasons for this, namely irregularity of quantity and quality in the supply and the want of business connection between producer and consumer. The landowner who wants to dispose one year of several thousand tons of mixed hard and soft wood, and another year of fifty large oaks, may have nothing to offer for sale in the third year, and in the fourth year comes into market with twenty acres of mature larch, will be lucky indeed if he can command a good market which he has been at no pains to deserve. No farm, no factory, no productive industry of any kind, could be run at a profit with such an utter absence

* Even Mr. H. J. Elwis, who has pronounced profitable forestry to be out of the question in the United Kingdom ('gambling in futures' is the term he applies to it) bears testimony to its capabilities for producing fine timber. In the introduction to the splendid work upon British trees which he is in course of producing in collaboration with Dr Henry, the authors state that 'after having seen the trees of every country in Europe, of nearly all the States of North America, of Canada, Japan, China, West Siberia and Chile, we confidently assert that the United Kingdom contains a greater number of fine trees from the temperate regions of the world than any other country.'

of system as prevails in most private woodlands. The merchant, knowing exactly what he wants, goes where experience tells him he is sure to get it, both as regards quantity and uniform quality. As these requisites can only be ensured in the produce either of virgin forest or in forest managed on a regular working plan of rotation, he naturally looks to foreign sources of supply.

Undoubtedly, although the British Isles are capable of producing timber of as high a quality as any other part of the world, *that which comes into the market is far inferior to that which is* grown in foreign countries. Ten years ago, or thereby (I forget the exact date), I was allowed to deal with this matter in the pages of this Review, and to refer to the mischievous tradition which encouraged the growth of branches instead of bole, producing coarse, knotted wood instead of clean long planks. Good timber can only be grown in close canopy, which kills off side branches, checks undue width of annual growth-rings, and by keeping down ground herbage, encourages the accumulation of forest soil. But close canopy is not ideal game cover, for which dense undergrowth can only be secured by thinning out the trees to an extent which ruins them as a crop. This was all very well in the days when it took 2,200 mature oaks, the more crooked the the better, to build a single one of Nelson's 'seventy-fours,' but it is a sad waste of fine material now that our battleships are all built *of iron. Modern cover shooting* is such a thoroughly artificial affair, depending not upon the natural stock of game, but upon thousands of hand-reared pheasants, that it requires no superhuman craft to adapt it to the conditions of well-grown forest. Indeed, it was from Germany, the home of scientific forestry, that the late Prince Consort imported the system of battue, now all prevalent in this country. Given a few advantageous 'ends' to put the birds over the guns in artistic style, and it is only a question of skill how to bring the game to those points. At Holkham, that Mecca of low-ground sport, there is, or used to be, one principal place—the hill called Scarborough—for successive rises throughout the day, the pheasants being manœuvred through miles of surrounding woodland to run the gauntlet of the guns at that spot.

Fortunately, the modern fashion of cover-shooting tends to discourage ground game, except in enclosed warren. 'Ground game,' say the Commissioners, 'has been the cause of immense destruction amongst the young trees, and thus it has, in a measure, directly brought about that condition of understocking which is so inimical to the growth of good timber and to the successful results of forestry. Nor is it possible, in the presence of even a moderate head of ground game, to secure natural regeneration of woodlands, the young seedling trees being nibbled over almost as soon as they appear above ground.'

This is far from stating the whole mischief caused by rabbits. The presence of these insatiable rodents entails a serious increase in the initial outlay of planting owing to the necessity for wire netting. To enclose a square block of sixty four acres takes 2,240 yards of 1¼ inch mesh, 42 inches wide, with 6 inches turned under the sod and larch posts to carry it. If this can be done for *6d.* a running yard (it certainly cannot be done for less), the cost of the whole fence will be 56*l.*, and this figure will be indefinitely increased where the enclosure is of irregular shape, as must often be the case. For instance, if the rectangle is twice as long as it is broad, it will require 2,805 yards of netting, costing 70*l.* 2*s.* 6*d.* Moreover, the smaller the area the greater the proportionate cost of enclosing it. A square of a single acre in extent takes 280 yards of netting=7*l.*; four acres in a square take 560 yards 14*l.* or 70*s* an acre; 1,024 acres in a square take 8,960 yards—224*l.*, or 4*s.* 4½*d.* an acre, and so on. Assuredly rabbits, even in moderate numbers, are the chief hindrance to forestry in this country, and where they abound, they are absolutely prohibitive of profitable tree growth.

Complaints are often heard about the effect of railway rates upon the traffic in home-grown timber, and railway companies are bitterly blamed for making preferential charges in favour of foreign timber. Such difference must always exist between regular and spasmodic traffic. The imports of foreign timber being regular in amount, in the ports of consignment and in their destination, the railway companies know pretty accurately how much rolling stock

will be required for the traffic and at what periods. They are able, therefore, to undertake the transport at rates far lower than they could accept for casual loads from wayside stations, where, perhaps, there is no crane or other appliance for dealing with weighty timber. This difficulty would disappear were British forests yielding a regular annual fall of fixed amount. Another circumstance affecting the carriage rates of timber usually escapes consideration, namely, that British timber, being in the round, is far more troublesome to handle than foreign timber, which is consigned either squared, or in planks or balks.

(2) Having before us the confident assurance of three Forestry Committees and a Royal Commission, that there are no physical or climatic impediments to the afforestation of large areas within these islands, and that the financial prospect of such an undertaking is so favourable as to justify the State in proceeding with it, there remains for consideration the social effect of the enterprise and the extent to which it may be expected to provide employment, permanent or temporary.

According to Continental experience, it appears that in established forest under rotation of eighty years, where the whole of the felling is performed by the regular forest staff, one man is employed throughout the year for every seventy-five acres. Add to this the subsidiary industries created by mature forest—carting, saw-milling, and the like—estimated by Professor Schlich as requiring the labour of three or four times the number of the forest staff, and there is employment in the proportion of one man to every eighteen acres of forest. It was estimated in 1906 that about 8,000,000*l*. was paid annually in salaries and wages for the administration, formation and preservation of German forests, representing the maintenance of about 200,000 families or about 1,000,000 souls, and that in working up the raw material yielded by the forests, wages were earned annually to the amount of 30,000,000*l*, maintaining about 600,000 families or three million souls.

The United Kingdom imports from Germany wood-pulp paper material and paper manufactured from woo to the value of between 8,000 000*l*. and 10,000,000*l*. per annum. All this might,

under proper system, be produced in the British Isles. There are or were not long ago, two or three pulping mills or cellulose factories in this country, but they have to import the soft wood required in that industry, for the simple reason that there are no woodlands in Britain managed on such a system as to ensure the miller a regular supply of raw material. Dr. Nisbet, writing in 1903, has described the genesis and growth of this great industry on the Continent :—

> The first wood pulp factory was started in Saxony about 1854, and the first cellulose factory about 1874. There are now in Germany alone, to say nothing of Austria, Sweden, and Norway, over 600 pulp-mills, using nearly 36,000,000 cubic feet of wood per annum, and seventy-one cellulose factories, consuming about 30,000,000 cubic feet. And these are comparatively new industries, capable of enormous expansion, and likely in time to raise the price of the softer woods suited for the trade—willow, poplar, birch, lime and the softer conifers.*

After all, considering that both the present generation and the next must have passed away before much of the forest about to be created is productive,† the matter of most concern to us is what immediate demand for labour may be anticipated from afforestation. Upon that point the Commissioners were guided by professional and other evidence before them that the operation of planting requires on an average the labour of twelve men upon every hundred acres during the planting season of five or six months,‡ and the permanent employment of one man to every hundred acres. Suppose, therefore, that the Department of Woods and Forests were to undertake the planting of their newly acquired estate of Inverliever at the rate of only 1,000 acres per annum, what would be the effect upon the local population? Hitherto it may be assumed that these 12,500 acres afforded employment for, say, seven or eight shepherds and three gamekeepers, ten or eleven men

* *The Forester*, vol. i., p. 84.

† The most rapid return from plantation known to the writer is that from eight acres at Taymount, which was planted, far too thinly, with Douglas fir in 1860. In 1900 the owner received an offer of 1,600*l.* for the trees, 1,796 in number, equal to 200*l.* an acre.

‡ The Corporation of Manchester plant annually 100 to 120 acres at Thirlmere, employing twenty men; the Corporation of Leeds accomplish 100 to 150 acres with a staff of twelve to fifteen men.

in all. Henceforward the temporary labour of 120 men would be required during six months, from October to March, and the permanent services of ten men throughout the year upon every 1,000 acres planted. At the end of thirteen years, after the whole area had been planted, 130 woodmen would be permanently employed nstead of the ten or eleven who were formerly occupied in tending sheep and game. In short, the class of land which is to be dealt with would support, if under forests, ten or twelve times the population which derives a living from it in its present condition.

So much for the effect of forestry as a source of permanent or periodical employment; but the question presents itself at once—to what can the extra or temporary hands turn when their six months' employment ceases in spring, and what amount of training do they require for the work allotted to them in the forest? The answer is found in the natural and intimate association which has been formed in several countries between forestry and small holdings. In Lord Lovat's Inverness-shire woods, for instance, extending to about 10,000 acres, much of the work is done by crofters paying 4*l.* or 5*l.* of annual rent. It is notorious that life can only be sustained on the average Highland croft at a level of bare subsistence, unless the crofter can supplement his means by fishing, acting as gillie to sportsmen, or by labour on a neighbour's larger farm. Given these aids, the croft is an inestimable boon, the *locus* of a comfortable and happy home; without them, it is, impossible to wring a decent living out of a few acres of arable ground and common grazing, as has been abundantly proved in the present year by the extent to which the general crofter population of the Highlands and the peasantry of Ireland have claimed and received old age pensions.

For an example of the stimulus given to small holdings by forest employment, we may turn once more to Germany:—

> It is almost a universal rule in Germany (said Professor Schlich in his evidence) that there are no permanent forest workmen, only the protective staff to look after and take care of the forest. The work . . . in the greater part of the country is done in winter, and by the same men as cultivate the land—small holders; some have one acre, some five, some up to ten, which they cultivate in summer, and when winter comes round and there is nothing to do in the fields they work in the forest.

Similar evidence came from other witnesses. Mr. Frith said that on the forestry demonstration area recently acquired by the State in Denbighshire, some of the men employed were small holders.

All this is very encouraging in connexion with the problem of small holdings , indeed, the key to their success seems to consist in the provision of suitable winter employment for the holder ; but it scarcely touches the existing difficulty of the unemployed. Even were the Government able and willing to start afforestation on a large scale immediately, it would be impossible to find work for more than a very small percentage of those whose necessity weighs so heavily upon the community in times of depressed trade. In the first place there is no means of lodging thousands of men in the regions which it is proposed to plant ; in the second place it would be unreasonable to expect anything but disappointment from setting city hands, untrained and uninured to exposure, to an unfamiliar kind of work in the bleakest parts of the country at the most inclement season of the year. Even hardy agricultural labourers, accustomed to spade and other outdoor work, require two or three weeks' instruction and close supervision before they can be trusted in the delicate, though simple operation of planting, upon the right execution of which the whole future of the forest depends.

Moreover, supposing it were possible to utilise the out-of-works in times of slack trade, how would their places be filled when industrial revival recalled them to their city homes? If the State forest is to justify itself, it must be run on business lines, and cannot be subjected to the irregularity inseparable from casual labour, Mr. Keir Hardie, M.P., struck the true note when he advocated extension of State forests 'not only to meet periods of temporary distress due to unemployment, but work which would permanently, enlarge the area of employment.' The special value of forestry on a large and systematic scale is that it calls for most labour in winter, when field labour is at its lowest and work is normally scarce, quite independently of the general condition of trade This applies with special force to Ireland, the evidence of

Mr. Doran, Chief Land Inspector of the Congested Districts Board, being very convincing on this point. He stated that out of some 220,000 agricultural labourers in Ireland, at least 24,000 migrate every year to England to seek employment. Most of these labourers have small agricultural holdings which occupy them during the spring and summer—the very class adapted for work in the forest. In bad seasons the Irish Government, said Mr. Doran, have been compelled to devise relief work of 'a comparatively useless character,' whereas if the State had possessed forest land in that country, which is better adapted than most other countries for the production of timber, this chronically surplus labour might have been put to good account by enriching the land for generations to come.

Unfortunately, a most ill-advised and disastrous experiment in forestry was begun by the Congested Districts Board in 1891. An area of 960 acres in Connemara on the barren wind swept seaboard of the Atlantic having been handed over to the Board by the Irish Land Commission, planting operations were vigorously started. Any experienced forester could have foretold the result. In 1895, out of two million coniferous trees and half a million hard woods planted nearly all were dead or dying except the worthless Austrian and mountain pines In 1898, after 10,500*l.* had been spent on the 'forest' of Knockboy, operations were suspended, and sceptics in British forestry were strengthened in their incredulity.

It is difficult to believe that the Report of the Royal Commission, endorsing, as it does fully, the conclusions reached by every preceding inquiry, can fail of effect in moving the Government to this great undertaking, even if something short of the full scheme put forward be the measure of their confidence. The two main inducements to action are to be found in the actual contraction in the available foreign supply, threatening the prosperity of our principal industries, nay, the very existence of some of them, and the expediency of providing rural employment of the most desirable kind as a counter-agency to the townward movement of the population. If any further justification for the enterprise be

required, it may be found in the argument of the Commissioners that 'Money expended in afforestation differs in kind from other calls on the national purse. It is a productive investment of capital. . . No stronger justification for proceeding by loan than a reproductive outlay exists.'—(*Nineteenth Century.*)

THE RUBBER INDUSTRY.

A RECENT DISCOVERY.

A discovery was made known last year, by one of the growers in Ceylon, of a different method from that hitherto employed for extracting from rubber trees the latex, or juice, which by subsequent treatment is turned into the raw rubber of commerce. Without going into more technical details, it is sufficient to say that instead of using a knife to make spiral, herring-bone, or V-shaped incisions in the bark, a pricking instrument is used which, it is claimed inflicts less injury upon the tree, produces a greater flow of latex, and enables young trees from three years old upwards, which cannot under present conditions be profitably tapped, to give a remunerative yield. After continuous experiments, and fortified by a favourable report upon the new method from Dr. J. C. Willis, Director of the Botanic Gardens, Peradeniya, Ceylon, Messrs. Lee, Hedges and Co., of Colombo, brought the discovery before the planting community, and on behalf of the patentee offered to make the new system known and available on payment of a fee of Rs 500 by each estate desirous of adopting it, subject to the condition that if it failed to possess the advantages claimed for it the sum paid would be returned. This transpired in November of last year. In the interval a large number of planters have decided to make the trial, and a recent communication from Colombo states that the new system will be adopted at once by many of the Ceylon plantations and that larger crops of rubber are expected than the estimates made at the beginning of this year.

The matter is obviously one of great interest to every one in the rubber trade, in view of the long period which elapses between the planting of young trees and their growth to an age and dimension which allows them to be tapped with safety and profit. It may be well, therefore, to enumerate the advantages claimed for the new system, to inquire whether there may be anything adverse to it not yet proven, and to consider what the general result of its universal adoption and established success might be.

The main advantages claimed for it are simplicity, reduction in cost of production, little or no damage to the trees, reduction in the labour force required, and quicker and increased returns. The points which, in the opinion of some who are well qualified to express them, are open for discussion are whether the latex from trees so young as those which it is now intended to tap will give rubber equal in elasticity and strength to that drawn from older and mature trees and whether the trees tapped so early may sustain some injury not discoverable at first but affecting them after the lapse of two years or more.

If, as seems probable, the new method is widely adopted in Ceylon, it will probably be also tried in the Malay States and the Further East, and should it prove as successful as it is claimed to be, the period of waiting for profitable returns from the immense area of young plantations made with British capital during recent times will be materially shortened. But it is also possible that in spite of the hesitation to change traditional habits characteristic of a backward race, the Brazilian planters and native gatherers of rubber may also acquire the necessary instruments and learn the new methods, in which case the time will be antedated when the total supplies available for the world's use will be very much heavier than they are now, which may affect market value until cheapness enables the material to be put to new uses. As this contingency has to be faced, it is satisfactory to know that the cost of producing rubber upon a plantation of mature trees in Ceylon and the Malay States is so low as to allow the value to decline several shillings per pound before the point is reached which leaves no profit to the planter.—*(Indian Trade Journal.)*

NATURAL AND ARTIFICIAL CAMPHOR

AN IMPORTANT LECTURE.

At the Congress of Applied Chemistry, on 29th May 1909, Professor Haller, whose lecture on the Chemistry of Camphor preceded the above, said that the extended use of camphor dated from the time when celluloid, of which it formed a constituent part, became the object of intensive and increasing manufacture. The important part it played in the industry of this plastic material, and the special qualities which it lent to the introcellulose with which it was incorporated, rencered it valuable for other purposes. It was used for the manufacture of pegamoid, a new substitute for leather, and entered into the composition of certain smokeless powders either as such or in the form of borneol. They were aware that camphor was prepared by distillation with steam from the wood of the camphor laurel, a fine tree which grew in Japan, in Formosa, where it still formed immense virgin forests more and more difficult of access, in various Japanese islands, and also in several districts of Central China. Since 1899 Japan had secured the monopoly of the camphor crop throughout its territory and in Formosa. According to statistics published in a Japanese journal and reproduced by the *Chemist and Druggist*, the amount of camphor exported from Japan increased from 280,892 kilos, valued at 200,452f., in 1868, to 1,834,594 kilos, valued at 130,691,831f., in 1907; and during the same time the price increased from 69f. to 708f. per 100 kilos. In spite of an increasing production in China it appeared from the statistical evidence that the aggregate *output of camphor was not increasing* and that they must rather expect to see it gradually diminish. And, since the demand on the contrary went on increasing, it was easy to understand the high prices reached, which had driven the camphor industry to make up the deficiency in the production of the natural substance.

It was about 1905 that the first attempts to supplement the supply by artificial camphor came into view. All the processes of manufacture started with pinene, a carbon compound found in the essential oil of turpentine. The latter was obtained by steam

distillation from the resin yielded by various conifers growing in the forests of the temperate zone. The principal countries of origin were, in order of importance, the United States, France, Russia, the Central European States, Germany and Austria. In recent years Spain had also contributed to the world's markets. The French essence produced from the sea pine was considered to hold the first place in respect of quality; that of the United States, from pitch-pine, was less valued; and those of Russia and Germany, obtained chiefly from the *Pinus silvestris*, were of inferior quality. The question of industrial camphor depended as much on the price of a good essence as on the methods employed. The efforts expended on the problem had resulted in no new fact or original discovery. The numerous methods employed were only improvements or variants of reactions previously known. They might be divided into two large groups according to whether the essence was first converted into hydrochlorate of pinene, or was submitted direct to the action of organic acids. The high prices of camphor, to which they owed the evolution of the new industry, had only been temporary, for reasons which it was extremely difficult to discover. Only those establishments which in the fortunate period of high prices found themselves in possession of an economical and thoroughly efficient process and were in a position to organize a prompt supply in response to the demand of the moment had been able to take advantage of the remunerative prices and recover the cost of installation. He should add that the camphor which they produced apart from its optical inactivity, possessed in all respects the same properties as natural camphor when it was sufficiently refined. Comparisons had been made between the camphor industry and the alizarine and indigotine industries, and some enthusiastic spirits had not been afraid to celebrate this new triumph of industrial science. With regard to the two substances mentioned, science and industry had incontestably got the better of nature. The cultivation of madder had completely disappeared from the departments of the Midi in France and artificial indigo was on the way to ruin the immense and numerous plantations of India, Java and

Guatemala. Would the same thing happen with camphor? It would be rash to say so, for various reasons which he enumerated. The conditions were very different both with regard to the supply of the natural product, the cultivation of which had been freshly stimulated, and with regard to the fundamental substance used in producing artificial camphor, namely, the essence of turpentine, the supply of which was limited and the price fluctuating. For these and other reasons the future of the camphor industry was uncertain.—(*The Times.*)

THE NORTH AMERICAN CONSERVATION CONFERENCE.

In consequence of it being realised that in North America the problems of conservation, like the resources with which they deal, are not confined to any of the three political subdivisions of the continent, and it being decided that these problems could be solved most effectively and economically by Canada, Mexico and the United States in co-operation, the President invited Lord Grey and President Diaz to participate with the United States in a conference at Washington on the conservation of the resources of North America.

The conference took place in February 1909, each country sending three Commissioners and, in addition, Newfoundland sent one. The outcome of the conference in the first place was a Declaration of Principles which our readers will doubtless like to peruse in full.

DECLARATION OF PRINCIPLES.

We recognise the mutual interests of the Nations which occupy the continent of North America and the dependence of the welfare of each upon its natural resources. We agree that the conservation of these resources is indispensable for the continued prosperity of each Nation.

We recognise that the protection of mutual interests related to natural resources by concerted action, without in any way interfering with the authority of each Nation within its own sphere, will result in mutual benefits, and tend to draw still closer the

bonds of existing goodwill, confidence and respect. Natural resources are not confined by the boundary lines that separate Nations. We agree that no Nation acting alone can adequately conserve them, and we recommend the adoption of concurrent measures for conserving the material foundations of the welfare of all the Nations concerned, and for ascertaining their location and extent.

We recognize as natural resources all materials available for the use of man as means of life and welfare, including those on the surface of the earth, like the soil and the waters; those below the surface, like the minerals; and those above the surface, like the forests. We agree that these resources should be developed, used and conserved for the future, in the interests of mankind, whose rights and duties to guard and control the natural sources of life and welfare are inherent, perpetual and indefeasible. We agree that those resources which are necessaries of life should be regarded as public utilities, that their ownership entails specific duties to the public, and that, as far as possible, effective measures should be adopted to guard against monopoly.

PUBLIC HEALTH.

Believing that the Conservation movement tends strongly to develop national efficiency in the highest possible degree in our respective countries, we recognize that to accomplish such an object with success, the maintenance and improvement of public health is a first essential.

In all steps for the utilization of natural resources considerations of public health should always be kept in view.

Facts which cannot be questioned demonstrate that immediate action is necessary to prevent further pollution, mainly by sewage of the lakes, rivers and streams throughout North America. Such pollution, aside from the enormous loss in fertilizing elements entailed thereby, is an immediate and continuous danger to public health, to the health of animals, and, when caused by certain chemical agents, to agriculture. Therefore, we recommend that preventive legislation be enacted.

FORESTS.

We recognize the forests as indispensable to civilization and public welfare. They furnish material for construction and manufacture, and promote the habitability of the earth. We regard the wise use, effective protection, especially from fire, and prompt renewal of the forests on land best adapted to such use, as a public necessity, and hence a public duty devolving upon all forest owners alike, whether public, corporate or individual.

We consider the creation of many and large forest reservations and their permanent maintenance under Government control absolutely essential to the public welfare

We favor the early completion of inventories of forest resources, in order to ascertain the available supply and the rate of consumption and reproduction.

We recommend the extension of technical education and practical field instruction in forest conservation, afforestation and reforestation, so as to provide efficient forest officers whose knowledge will be available for necessary public information on these subjects.

Believing that excessive taxation on standing timber privately owned is a potent cause of forest destruction by increasing the cost of maintaining growing forests, we agree in the wisdom and justice of separating the taxation of the timber land from the taxation of the timber growing upon it, and adjusting both in such a manner as to encourage forest conservation and forest growing.

We agree that the ownership of forest land, either at the headwaters of streams or upon areas better suited for forest growth than for other purposes, entails duties to the public, and that such lands should be protected with equal effectiveness, whether under public or private ownership.

Forests are necessary to protect the sources of streams, moderate floods and equalize the flow of waters, temper the climate and protect the soil; and we agree that all forests necessary for these purposes should be amply safeguarded. We affirm the absolute need of holding for forests, or reforesting, all lands supplying the headwaters of streams, and we therefore favor the control or acquisition of such lands for the public.

The private owners of lands unsuited to agriculture, once forested and now impoverished or denuded, should be encouraged by practical instruction, adjustment of taxation and in other proper ways, to undertake the reforesting thereof.

Notwithstanding an increasing public interest in forestry, the calamitous and far-reaching destruction of forests by fire still continues, and demands immediate and decisive action We believe that systems of fire guardianship and patrol afford the best means of dealing adequately with fires which occur, whether from natural causes, such as lightning, or in other ways; but we affirm that in addition thereto effective laws are urgently needed to reduce the vast damage from preventable causes.

Apart from fire, the principal cause of forest destruction is unwise and improvident cutting, which, in many cases, has resulted in widespread injury to the climate and the streams. It is therefore of the first importance that all lumbering operations should be carried on under a system of rigid regulation.

WATERS

We recognise the waters as a primary resource, and we regard their use for domestic and municipal supply, irrigation, navigation and power, as interrelated public uses, and properly subject to public control. We therefore favor the complete and concurrent development of the streams and their sources for every useful purpose to which they may be put.

The highest and most necessary use of water is for domestic and municipal purposes. We therefore favor the recognition of this principle in legislation, and, where necessary, the subordination of other uses of water thereto.

The superior economy of water transportation, overland transportation as well as its advantages in limiting the consumption of the non-renewable resources, coal and iron, and its effectiveness in the promotion of commerce, are generally acknowledged. We therefore favor the development of inland navigation under general plans adapted to secure the uniform progress of the work and the fullest use of the streams for all purposes. We further express

our belief that all waterways so developed should be retained under exclusive public ownership and control.

We regard the monopoly of waters, and especially the monopoly of water-power, as peculiarly threatening. No rights to the use of water-powers in streams should hereafter be granted in perpetuity. Each grant should be conditioned upon prompt development, continued beneficial use and the payment of proper compensation to the public for the rights enjoyed; and should be for a definite period only. Such period should be no longer than is required for reasonable safety in investment. The public authority should retain the right to readjust at stated periods the compensation to the public and to regulate the rate charged, to the end that undue profit or extortion may be prevented.

Where the construction of works to utilize water has been authorized by public authority and such utilization is necessary for the public welfare, provision should be made for the expropriation of any privately owned land and water-rights required for such construction.

The interest of the public in the increase of the productiveness of arid lands by irrigation and of wet lands by drainage is manifest. We therefore favor the participation of the public to secure the complete and economical development and use of all water available for irrigation and of all lands susceptible of profitable drainage, in order to ensure the widest possible benefit. Special projects should be considered and developed in connection with a general plan for the same watershed. In the matter of irrigation public authority should control the headwaters and provide for the construction of storage reservoirs and for the equitable distribution and use of the stored water.

LANDS.

We recognize land as a fundamental resource, yielding the materials needed for sustaining population, and forming the basis of social organization. Increase in the productivity of the soil is a growing need, and the possession of the land by the men who live upon it not only promotes such productivity, but is also the best guarantee of good citizenship. In the interest of the homemaker,

we favor regulation of grazing on public land, the disposal of public lands to actual settlers in areas, each sufficient to support a family, and the subdivision of excessive holdings of agricultural or grazing land, thereby preventing monopoly.

The preservation of the productivity of the soil is dependent upon rotation of crops, fertilization by natural or artificial means, and improved methods in farm management. The quantity and quality of crops are also dependent upon the careful selection of seed. We therefore favor the distribution by Government bureaus of scientific and practical information on these points, and we urge upon all farmers careful attention thereto.

The national importance for grazing of non-irrigable public lands too dry for cultivation, and the public loss occasioned by overgrazing, are generally acknowledged. We therefore favor Government control of such lands in order to restore their value, promote settlement and increase the public resources.

The first requisite for forest or other covering which will conserve the rainfall and promote regularity of waterflow is the retention of the soil upon watersheds.

We therefore favor the construction of such artificial works as may effect this purpose and the encouragement thereof by remission of taxes, Government co-operation, or other suitable means.

MINERALS.

We recognize the mineral resources as forming the chief basis of industrial progress, and regard their use and conservation as essential to the public welfare. The mineral fuels play an indispensable part in our modern civilization. We favor action on the part of each Government looking towards reduction of the enormous waste in the exploitation of such fuels and we direct attention to the necessity for an inventory thereof. Such fuels should hereafter be disposed of by lease under such restrictions or regulations as will prevent waste and monopolistic or speculative holdings, and supply the public at reasonable prices.

We believe that the surface rights and underground mineral rights in lands should be separately dealt with so as to permit the

surface of the land to be utilized to the fullest extent, while preserving Government control over the minerals.

Regulations should be adopted looking to the most economical production of coal and other mineral fuels and the prolongation of the supply to the utmost. We favor also the substitution of water-power for steam or other power produced by the consumption of fuel.

Great economy in the use of fuel has resulted in the past from the application of scientific inventions and the use of improvements in machinery, and further progress can be made in the same direction. We therefore recommend that all possible encouragement and assistance be given in the development and perfecting of means whereby waste in the consumption of fuel can by reduced.

The loss of human life through preventable mining accidents in North America is excessive. Much needless suffering and bereavement results therefrom. Accompanying this loss there is great destruction of valuable mineral property and enhancement of the cost of production. The best method of eliminating these known and admitted evils lies in the enactment and strict enforcement of regulations which will provide the greatest possible security for mine-workers and mines. We therefore favor the scientific investigation of the whole subject of mine accidents by the Governments participating in this conference, the interchange of information and experience and the enactment and enforcement of the best regulations that can be devised.

Mineral fertilizers should not be monopolized by private interests, but should be so controlled by public authority as to prevent waste and to promote their production in such quantity and at such price as to make them readily available for use.

PROTECTION OF GAME.

We recognize that game preservation and the protection of bird life are intimately associated with the conservation of natural resources. We therefore favor game protection under regulation,

the creation of extensive game preserves and special protection for such birds as are useful to agriculture.

CONSERVATION COMMISSIONS.

The action of the President of the United States in calling th s first conference to consider the conservation of the natural resources of North America was in the highest degree opportune, and the proceedings which have followed, and the information mutually communicated by the representatives assembled, have, we believe, been conducive to the best interests of the countries participating. To derive the greatest possible benefit from the work which has already been done, and to provide proper and effective machinery for future work, there should be established in each country a permanent Conservation Commission.

When such Conservation Commissions have been established, a system of intercommunication should be inaugurated, whereby, at stated intervals, all discoveries, inventions, processes, inventories of natural resources, information of a new and specially important character, and seeds, seedlings, new or improved varieties, and other productions which are of value in conserving or improving any natural resource shall be transmitted by each Commission to all of the others, to the end that they may be adopted and utilized as widely as possible.

WORLD CONSERVATION CONFERENCE.

The conference of delegates, representatives of the United States, Mexico, Canada and Newfoundland, having exchanged views and considered the information supplied from the respective countries, is convinced of the importance of the movement for the conservation of natural resources on the continent of North America, and believes that it is of such a nature and of such general importance that it should become world-wide in its scope, and therefore suggests to the President of the United States of America that all Nations should be invited to join together in conference on the subject of world resources and their inventory, conservation and wise utilization.

GIFFORD PINCHOT, ROBERT BACON, JAMES RUDOLPH GARFIELD, *Commissioners representing the United States.*

SYDNEY FISHER, CLIFFORD SIFTON, HENRI S. BELAND, *Commissioners representing the Dominion of Canada.*

ROMULO ESCOBAR, MIGUEL A. DE. QUEVEDO, CARLOS SELLERIER, *Commissioners representing the Republic of Mexico.*

E. H. OUTERBRIDGE, *Commissioner representing the Colony of Newfoundland.*

Attest: ROBERT E. YOUNG, THOMAS R. SHIPP } *Secretaries of the Conference.*

Washington D. C., February 23, 1909.